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The "Ridley" Report

A Committee on National Fuel Policy, appointed by the Minister of Fuel and Power of the Government in office in July, 1951, has now issued its findings which have already become known as the Ridley Report* after the chairman, Viscount Ridley, C.B.E. The main conclusion of the Report is that a Joint Fuel and Power Planning Board should be established. We think this has been misnamed as it has every appearance of being an advisory body. We are not impressed with the term "planning" for most committees and boards of directors do much planning but take it in their stride. Conditions in the power and fuel industry have so materially changed since the Committee started its work that any "planning" based on the conditions of years prior to 1951 and 1952 would too strongly savour of panic legislation to be of lasting benefit.

A part of the Report which is of much interest to the foundry industry is that devoted to the domestic use of fuel and power. From the Report we learn that coal is more efficiently consumed in a modern stove than when converted into gas or electricity. This efficiency is increased when water-heating is incorporated in the appliance. For quite short periods of heating, electricity or gas is the more economical, and so the story continues, but we claim this has been general knowledge in technical circles for a long time. This is no criticism of the Report, for committees must state cases before making recommendations, so it is to the latter we turn as being of major importance.

Amongst these recommendations are:—That new standards of performance for solid-fuel-fired stoves should be prepared so as to give a room efficiency of 40 per cent.—whatever that means—and apparatus not carrying an official certificate of efficiency should be subject to a 100 per cent. purchase tax; that the retail sale of insulation material should be encouraged; and financial incentives should be given to aid the sales of "officially" efficient plant. Here we may interject the comment that surely the 100 per cent. purchase tax on the "inefficient" should cause the total to exceed the price of the "efficient" by a sufficient differential. It was further recommended in the Report that the Government should launch a publicity campaign in favour of the modern stove and for house insulation and the makers of efficient stoves were recommended to publish new or better lists. As the makers of stove grates have very largely been pursuing a forward policy for some years, they will find much in the Report of a confirmatory character emphasizing the steps they are taking and have taken to promote efficiency.

* "Report of the Committee on National Policy for the Use of Fuel and Power Resources," Command 8647, H.M.S.O., 6s. 6d. net.

Notes from the Branches

Lancashire

A party of approximately fifty members of the Lancashire branch of the Institute of British Foundrymen paid a visit to the Renishaw Iron Works as the guests of the chairman and managing director, Mr. J. F. Stanier. They were conducted round the plant by senior members of the staff and were shown the various processes necessary in the production of foundry pig-iron.

During the course of welcoming the guests, Mr. Stanier stressed that at Renishaw a great deal was being done in the training of apprentices, and announced that to mark the occasion of his friend Mr. Yeoman's year of office as president, it had been decided by the directors of the Renishaw Iron Company Limited, that the company should give a prize to the best apprentice of the year in the Lancashire branch.

Sequel to Keith Blackman Fires

A confession of how he twice set fire to the engineering works of Keith Blackman Limited, High Street, Arbroath, last year, was related at Dundee Sheriff Court recently. George Watson, a 46-year-old moulder employed by the firm, admitted two charges of wilful fire-raising at the premises on June 15 and October 2, 1951. He also pleaded guilty to forcing the gas meter in his home and four previous convictions for dishonest appropriation of property were also admitted. Fortunately the fire was discovered early and damage was limited to about £500. The second outbreak was two days later and the total damage in the two fires was given as £20,000.

At Glasgow High Court on September 11 Watson was sent to prison for two years when he admitted the charges of fire-raising in June and October last year. Mr. Norman Sloan, advocate deputy, described the crime as one which had "no motive at all." He said Watson had been examined by psychiatrist who was of opinion that he was fit to plead and was responsible for his actions. Watson, so far as was known, was not on bad terms with his employers; and, indeed, he believed that after setting the premises on fire the man had assisted in putting the fire out.

Prime Minister on Steel

Before flying to the South of France for a well-earned holiday with Mrs. Churchill, the Prime Minister visited his own constituency of Woodford (Essex). There, as well as striking a more optimistic note about the balance-of-payments position, and complimenting the T.U.C. on its "wise statesmanship" over wages restraint, he defended the Government's proposed Steel Bill, which, he said, would be introduced in the new session of Parliament in November. Mr. Churchill described the preservation of the separate identity and independence of the great steel companies whose reputations and trade connections were worldwide, as "important national assets." Tory policy for the steel industry, he declared, was founded upon political needs and experience. The system of organization and supervision which they proposed had been progressively evolved by the industry itself over the last 20 years, and its general conception followed closely the views expressed by the T.U.C. in its report on the public supervision of industry. The main step they were taking in reconciling State supervision and control with free enterprise was one which sprang as much from the minds of trade unionists as from employers.

Conference Paper Author

Mr. Louis Grand is the Author of the French exchange Paper to the Buxton Conference of the Institute of British Foundrymen, entitled "Sand-cast Beryllium Bronze," printed on the adjoining pages. He is an Ingénieur-Chimiste F. C. S. I. and a Licencié ès Sciences. Mr. Grand entered the employ of the Péchiney Company in 1927, when he was 22, and has held successively the posts of joint production manager of magnesium at the works at Chedde (Haute-Savoie); chief of the manufacture of ferro-alloys at Chedde, and his present position as research director at Chambéry.

Progress with Avery's New Foundry

A grey iron foundry, which is to be one of the finest of its type in the world, is steadily taking shape at Tamebridge, near the boundary of Walsall and West Bromwich, Staffordshire. Nearly £1,250,000 is being spent on the building and plant by the well-known scale-making firm of W. & T. Avery, Limited, of Smethwick.

Since the first bulldozer rumbled across the land a little over 12 months ago, the levelling of the site, the demolition of war-time buildings and the laying of foundations have gone ahead rapidly. Steel shortage has caused a delay in the construction of the main foundry building, but supplies have been sufficient for the contractors to go forward with the amenity block. Much of the brickwork has been completed for this block, which will house offices, shower-baths, locker-rooms and a canteen. Foundations, reaching in places to a depth of 15 feet, have been laid for the rest of the foundry and the steel supplies are expected to be coming in steadily by the end of the year. First production from the foundry is expected early in 1954.

Oldest Iron Foundry?

From last Tuesday's Daily Telegraph.—"What is believed to be Britain's oldest known iron foundry, of the first century B.C., has been discovered at Kingsley, Hants."

British Moulding Machine Company, Limited, Faversham, Kent, are showing their model B.T.5 machine at the Zabreb International Trade Fair and Mr. H. J. Bullock leaves for Yugoslavia on Saturday to supervise arrangements.

Paris International Foundry Conference (1953).—In our issue of August 28, the impression was given that October 30 was the last day for the receipt of typescript of papers offered for presentation whereas this date is actually the dead line for receiving offers of papers.

I.B.F. Seventh Annual Golf Competition.—A record number of entries is reported by Mr. F. Arnold Wilson, the hon. secretary of the Institute of British Foundrymen's Golfing Society, for the seventh annual meeting on September 27 and 28 at Woodhall Spa. There are to be 44 competitors and 75 in all; a Bogey Competition has been arranged for the ladies.

Sand-cast Beryllium-bronze*

By L. Grand

Beryllium-bronze is one of the high-grade bronzes, due partly to its excellent casting properties, its good working qualities, the ease with which it can be rolled, drawn, swaged, forged or pressed, and finally to its mechanical strength, in which regard it occupies a unique position in the range of copper alloys. Although the development of the uses of beryllium-bronze is to some extent hampered by its high cost, it is probable that this alloy would be more widely used if it were better known and in this Paper is attempted the elucidation of some of its properties.

Composition of Copper/Beryllium Alloys

The solubility of beryllium, which alloys with liquid copper in all proportions, varies from 2.1 to 0.40 per cent., as the temperature falls from 865 deg. to 15-20 deg. C. Only the beryllium-bronze with the percentage composition: Cu 97.2 to 97.8, Be, 1.9 to 2.3, Ni or Co, 0.30 to 0.50 per cent., is of practical interest. The nickel or cobalt is not essential in the particular case of castings, since these constituents have the sole object of preventing grain coarsening as a consequence of recrystallization in the heat-treated alloy.

Micrographic structure.—The micrographic examination of samples polished electrolytically (in *Jacquet's* phosphoric bath) demonstrates the presence in the metal as-cast, of an eutectoid ($\alpha + \gamma$)—(see Fig. 1, according to R. H. Fillnow and D. J. Mack, in the *Journal of Metals*, No. 10 of October, 1950) and impurities are located on the crystal boundaries of the α solid solution. After annealing, the eutectoid is replaced by an $\alpha + \beta$ phase ($\alpha + \gamma = \alpha + \beta$), but the β constituent is only partially in solution (in the case of rolled bronze, β is not completely absorbed even after 100 hrs. heating at 800 deg. C.). Figs. 2 and 3 illustrate the extent and the development of the β phase after one hour's heating at 720 and 800 deg C. respectively.

Tempering treatment causes decomposition of the α and β phases. Fig. 4 shows the beginning of this development, in the β phase, characterized by striations preceding the appearance of alternate scales of α and γ. A recent investigation by the research department of the Pechiney Company, soon to be published, has shown the precipitation within the α solid solution of a γ phase, causing hardening. If tempering is continued beyond the optimum period, γ is absorbed in favour of the γ phase, which develops and produces a softening of the metal.

Macrographic Structure.—The macrostructure of beryllium-bronze castings is governed by the rate of solidification; the grain being the coarser, the slower the solidification. The addition of elements such as boron (0.1 to 0.2 per cent.), zirconium (about 0.1 per cent.), or titanium, enables the metal to be "refined," independently of the pouring (temperature) or casting (type of mould, or sectional thickness of the casting) conditions (see Fig. 5). However, the modification of the structure is irregular and often barely perceptible in the presence of nickel, in the case of boron or zirconium.

The effect of titanium, on the other hand, is very marked, and regular for percentages of or over 0.02 to 0.03 per cent. Since the melting point of bronze (975 deg. C.) increases appreciably and rapidly with the titanium concentration (by 100 deg. C. for 0.10 per cent. Ti approximately), there is no purpose in pushing the concentration beyond 0.03 to 0.05 per cent. The presence of titanium (Ti $\leqq$ 0.10 per cent.) does not hinder the rolling of beryllium-bronze, and can but be favourable for the homogeneity of the alloy.

Castability. — The castability or fluidity of beryllium-bronze is below that of brass, equal to or slightly better than that of aluminium bronze, and clearly superior to that of tin bronze. (See Table I.) The castability is practically halved if the beryllium content is reduced from 2.2 to about 1.40 per cent. at the same temperature.

Pouring Temperature. — Recommended values are:—

Thick castings (thickness $\frac{1}{8}$ to $\frac{1}{2}$ in.) 1,030 to 1,050 deg. C.

Ordinary casting, 1,050 to 1,100 deg. C.

Thin castings, or those incorporating thin sections, 1,100 to 1,200 deg. C.

Shrinkage.—The shrinkage of beryllium bronze

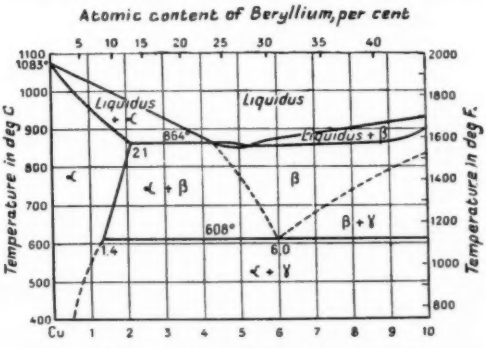


FIG. 1.—*Copper/Beryllium Equilibrium Diagram.*

* Official Exchange Paper from *l'Association Technique de Fonderie* presented to the Buxton Conference of the Institute of British Foundrymen. The Author is attached to the *Service des Recherches et Essais Physiques de Chambéry.*

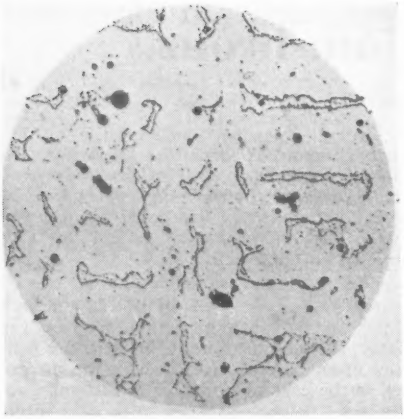


FIG. 2.—*Photomicrograph of Beryllium-bronze, quenched after 1 hr. at 720 deg. C., × 134, showing Extent and Development of the β Phase.*

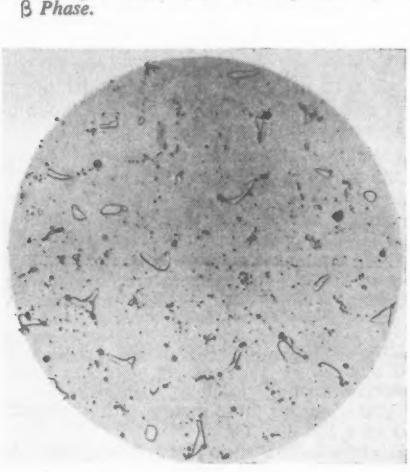


FIG. 3.—*Beryllium-bronze, quenched after 1 hr. at 800 deg. C., × 134, showing Development of the β Phase.*

depends on the static pressure of the feeder heads and the shape of the casting.

Contraction in the open air, 1.5 per cent.

Shrinkage in a mould, 1.0 to 1.2 per cent.

Pipes and micro-piping. — Aluminium bronze "pipes" heavily if not cast with a sufficient feeding head. Beryllium-bronze does not "pipe" so heavily, but is subject to micro-piping (porosity), in which respect it resembles bronze with 20 per cent. tin (see Fig. 6). Judicious use of heads or chills enables this to be easily remedied.

Cracks.—Unless casting conditions are very unsatisfactory, sand-cast beryllium-bronze shows little tendency to cracking, since this alloy is not hot-short.

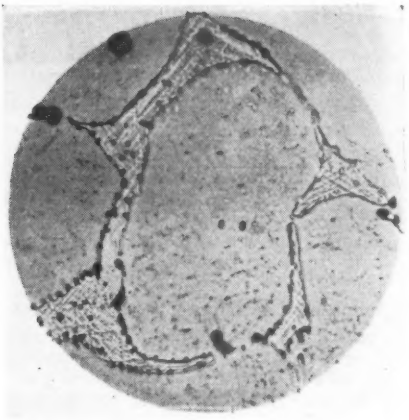


FIG. 4.—*Beryllium-bronze, quenched and tempered, × 730, showing Incipient Decomposition of the α and β Phases.*

Draws. — This defect, appearing as vermiform piping on the surface, is occasionally observed on very thick castings (2½ to 3 in.), but only where the effect of feeders, or the like, no longer penetrates. Beryllium-bronze is practically free from draws.

Gassing.—Beryllium-bronze melted in crucibles in an oil- or coke-fired furnace, is not gassy and can safely be cast in green-sand moulds, since this alloy does not react in contact with the moisture of the mould. (Table II.) On the other hand, when melting wet or oily turnings, or if charcoal is introduced into the melt without preheating, the metal absorbs such a volume of gas that even with rapid cooling in cast-iron moulds, violent "spitting" is observed and very porous ingots are obtained.

Spitting in the feeders has also been observed, even though the metal is itself free from gas, if the metal is poured from too great a height, thus causing air to be entrapped. Prior degreasing and thorough drying of beryllium-bronze scrap is therefore advisable. In all cases, the metal can be degassed by holding it for about half an hour at 1,030 to 1,050 deg.; or, more reliably, by casting into ingots and remelting.

Oxidation in Contact with Air during Melting

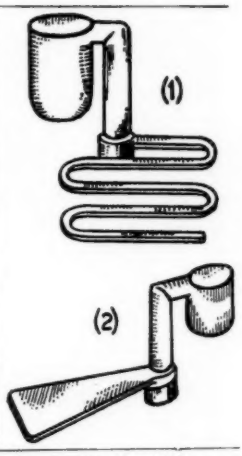
The oxidation of bronze in contact with air at high temperatures depends essentially on the size of the pieces of metal. In the case of finely divided scrap melted without precautions, the loss of beryllium may reach 40 to 60 per cent.

Ingots or large scrap.—For these the melting losses are shown in Table III.

Turnings or small croppings.—Methods of treating these consist of:—(*a*) The scrap is quickly plunged in a bath of molten metal or (*b*) the same procedure, but with a layer of molten flux covering the bath. (See Table IV.) A suitable flux is barium or sodium chloride. The latter, being volatile, emits fumes which may be troublesome in the casting shop. Of course, no salts capable of reacting

TABLE I.—*Relative Castability of Bronze and Brass Alloys.*

	Castability values.					
	Coil shape.(1)			Fan shape.(2)		
Pouring temperature, deg. C.	1,050	1,080	1,180	1,050	1,080	1,180
Beryllium-bronze ..	32 to 36	32 to 36	81 to 83	70 to 74	70 to 74	230 to 250
Brass (35 per cent. Zn)	—	58	—	—	190 (approx.)	—
Tin bronze (10 per cent. Sn)	—	11	37	—	8	45
Aluminium bronze (9 per cent. Al, 2 per cent. Mn)	—	31	68	—	60	235 (approx.)



(1) Trapezoidal cross-section; bases 7 and 11 mm.; height 11 mm. (2) Thickness 3 mm.; length 295; extreme breadths 40 and 165 mm.

with beryllium (AlF_3 (cryolite) or others), may be used, since besides the loss of beryllium, the vapours of beryllium salts are toxic. In the presence of aluminium fluoride, the loss of beryllium may attain 25 to 30 per cent., depending on the weight of the fluoride, and whether the metal and the flux have been rabbled or stirred or not. The use of a suitable flux, not only enables beryllium losses to be reduced, but aids degassing of the metal.

Oxidation in Contact with Air during Casting

The results set out in Table V give an idea of the loss in beryllium, by oxidation in contact with air at varying temperatures, for the case of a thin stream of metal falling from a height of 30 cm. (12 in.) (according to Losanna, in *La Metallurgia Italiana*).

Segregation.—The segregation taking place during solidification of the metal is expressed by the variation in the beryllium content of different parts of the casting, normally not exceeding 0.20 per cent. approximately. (See Table VI.)

Mechanical Properties

The mechanical strength characteristics of beryllium-bronze depend on the composition, purity and structure of the alloy; and also on the conditions of heat-treatment and casting. Where not otherwise stated, the mechanical properties mentioned in this Paper have been determined on samples of the following dimensions: diameter of bar 13.8 mm. (0.545 in.), useful length 105 mm. (4 in.), total length 185 mm. (7¼ in.). The alloy was water-quenched (after 1 hr. at 720 deg .C.), and tempered (5 hr. at 280 to 300) in air-blast furnaces.

Influence of Composition.—Table VII shows the development of the mechanical strength, depending, other things being equal, on the beryllium content. The optimum limiting beryllium percentages are about 1.9 and 2.2 per cent.

TABLE II.—*Influence of Sand Moisture Content on Product Density.*

Moisture content of sand, per cent.	Density (mean of three measurements). I	Density (mean of three measurements). II	Remarks.
Nil (dried mould) ..	8.20	8.22	Casting temperature, deg. C.:—
7	8.30	8.31	I—1,130-1,150
8	8.20	8.14	II—1,170-1,200
10	8.20	8.16	

Samples taken from a bar of 48 by 35 by 330 mm. (1.9 by 1.4 by 13.0 in.) cast horizontally in a two-part mould.

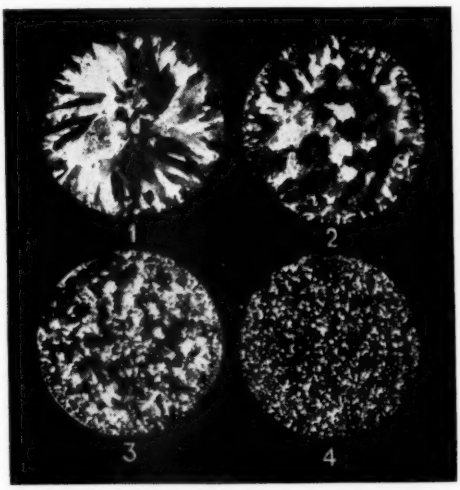


FIG. 5.—*Grain Refinement of Bronze by Zr, Ni and Ti*: (1) *Ordinary Bronze;* (2) *Ordinary Bronze with* 0.10 *per cent. Zr;* (3) *Copper/Beryllium Alloy* 0 *per cent. Ni,* 0.10 *per cent. Zr;* (4) *Ordinary Bronze,* 0.03 *per cent Ti.*

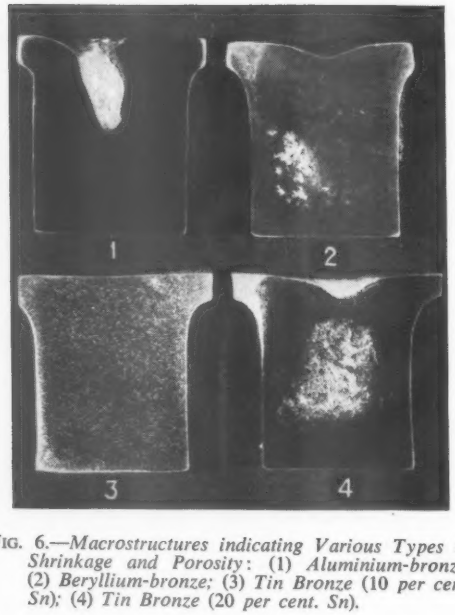


FIG. 6.—*Macrostructures indicating Various Types of Shrinkage and Porosity*: (1) *Aluminium-bronze;* (2) *Beryllium-bronze;* (3) *Tin Bronze* (10 *per cent. Sn*); (4) *Tin Bronze* (20 *per cent. Sn*).

TABLE III.—*Melting Losses for Ingot or Large Scrap.*

State of metal.	Percentage Be			Loss of Be in per cent. of original content.	Total smelting loss (Cu and Be).
	At start.	After three melts.	Difference.		
Ingots Length, 400 mm. (15.8 in.) .. Cross-section 45 by 70 by 60 mm. (1.8 by 2.8 by 2.4 in.)	2.0	1.78	0.07	3.6	2.2 to 2.7 per cent.
Slabs Length, 150 mm. (6 in.) Cross-section 80 by 5 mm. (3.1 by 0.2 in.)	1.85	1.66	0.06	3.4	

Influence of Impurities.—The values given in Table VIII give a rough idea of the influence of some impurities, considered jointly, on the mechanical strength under static loading. Magnesium is particularly harmful, since it forms with copper a eutectic alloy (Mg 9.7 per cent.) melting at 730 deg. C. In a concentration of 0.20 to 0.50 per cent. this element may cause coalescence at the crystal boundaries, even leading to " burning " of the metal if the quenching temperature exceeds about 780 to 800 deg. C. In proportions below 0.04 per cent. lead is harmless. Aluminium behaves like magnesium in proportions above about 1.0 per cent. (see Table IX).

Influence of metal structure.—The macrostructure does not appear to have any outstanding influence on the mechanical strength under static load. On the other hand, the fatigue limit of the sand-cast metal is improved by about 40 per cent. if the grain be refined by adding titanium (see later).

Heat-treatment.—Increasing the quenching temperature from 720 deg. C. to about 800 deg. C. appears to have a slight, favourable influence on the mechanical properties of beryllium bronze.

TABLE IV.—*Metal Losses When Melting Turnings or Croppings.*

Treatment (see below).	State of metal.	Percentage Be.		Difference.	Loss of Be as percentage of initial content.
		At start.	After one melt.		
(*a*)	*Turnings*: e = 30/100 to 5/100 ..	2.04	1.70	0.34	16
	Sheet croppings: e = 5/100 to 20/100 ..	2.15	1.70	0.45	20
(*b*)	*Turnings*: e = 30/100 to 50/100 ..	2.04	1.80	0.24	12

Treatment (*a*) scrap rapidly immersed in the bath of molten metal and (*b*) the same, but the bath of metal previously covered with a layer of molten flux.

TABLE V.—*Loss in Beryllium on Pouring a Thin Stream of Alloy from 30 cm.* (12 *in.*)

Temperature, deg. C.	Be-content, per cent.
1,020	2.48
1,050	2.48
1,070	2.46
1,100	2.45
1,120	2.41
1,150	2.35
1,200	2.18

TABLE VI.—*Segregation during Solidification as shown by Change in Be Content.*

Dimensions: 200 by 200 by 250 mm (8 by 8 by 10 in.)
Thickness: 20 to 50 mm. (0.8 to 2.0 in.)

Reference sample No.	Be, per cent.
1	2.02
2	1.88
3	1.98
4	2.00
5	2.04
6	2.05

TABLE VII.—*Mechanical Properties According to Be Content.*

Per cent. Be.	Mechanical strength values (metal hardened and tempered).		
	Ultimate tensile strength, kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.	Brinell, Hardness.
1.30–1.40	70 to 75 (44 to 47.5)	4 to 5	230 to 240
1.90–2.0	85 to 95 (54 to 60)	1 to 2	340 to 360
2.10–2.20	90 to 100 (57 to 63.5)		
2.40–2.50	105 to 110 (67 to 70)	0 to 1	380 to 390

ED. NOTE.—In this and other tables equivalent values in tons per sq. in. are given in parentheses.

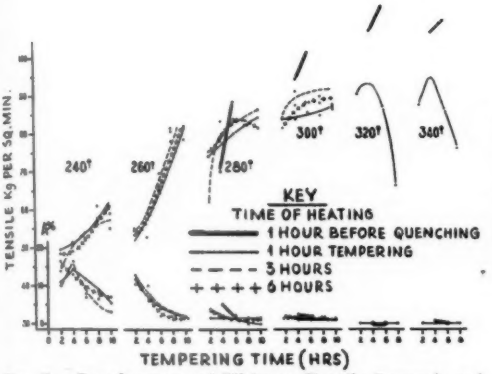


FIG. 7.—*Development of Ultimate Tensile Strength and Elongation (A) against Temperature and Tempering Time.*

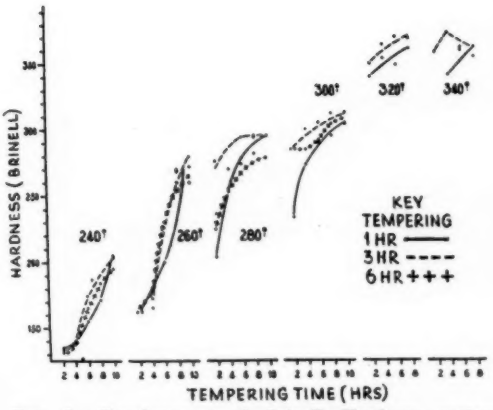


FIG. 8.—*Development of Brinell Hardness against Temperature and Tempering Time.*

Moreover, the tempering time can be slightly decreased, at least at temperatures of or below 280 deg. C. (see Table X).

The development of the mechanical properties: ultimate tensile strength, percentage elongation and hardness, depending on the annealing and tempering temperatures, is illustrated by the curves (Figs. 7 and 8). In the case of an impure bronze and particularly if contaminated by magnesium (0.2 to 0.5 per cent.), the results of the tensile tests scatter very widely as soon as the annealing and hardening temperatures exceed 720 and 300 deg. C., respectively; notably, a considerable drop in the mechanical strength is observed when tempering is continued beyond 4 to 5 hours, at temperatures exceeding 300 deg. C.

The optimum heat-treatment conditions may be summarized as follows:—(1) the alloy is required to retain a certain amount of elongation (1 to 2 per cent.): Quench after 1 to 3 hrs. at 720 to 800 deg. C. Temper 4 to 5 hrs. at 280 to 300 deg. C.

(2) For maximum hardness: Quench after 1 to 3 hrs. at 720 to 800 deg. C. Temper 4 to 5 hrs. at 320 to 340 deg. C.

The annealing temperature selected should depend on the purity of the alloy.

Influence of casting condition.—The mechanical strength of beryllium-bronze castings appears to be independent of the material of the mould (see Table XI). The influence of the arrangement of the mould is, on the other hand, very marked (see Table XII).

Mechanical properties of a casting.—The mechanical strength values given in Table XIII apply to a spanner (dimensions: heads 55 by 75 and 60 by 80 mm., thickness 20 mm., shaft 200 mm. (8 in.) long, 35 mm. wide, 10 mm. thick) which has been heat-treated (quenched after 2 hrs. at 720 deg. C.; tempered 2 hrs. at 300 deg. C.). The results were obtained with test-bars of the following dimensions: 4 mm. dia., gauge length 32 mm. (1¼ in.), total length 50 mm.

Fatigue limit.—The fatigue limit of sand-cast beryllium-bronze, as determined by the Alken rotary bending test, is practically independent of the annealing temperature between 720 and 800 deg. C., and of the purity of the metal, at least within the limits given in this Paper. The fatigue limit is, however, greatly influenced by the structure of the metal, *viz.*:—

Metal not refined, hardened and tempered: tensile, 11 to 12 kg. per sq. mm. (7.0 to 7.6 tons per sq. in.); metal refined with titanium, hardened and tempered: tensile, 15 to 16 kg. per sq. mm. (9.5 to 10.2 tons per sq. in.); and rolled metal, hardened and tempered: tensile, 26 to 27 kg. per sq. mm. (16.5 to 17.2 tons per sq. in.).

Casting

Moulding sand.—Beryllium-bronze can be cast in all sands suitable for casting copper alloys and in the normal conditions of dryness.

Runners and feeders.—All things being equal, beryllium-bronze requires less metal in runners and feeders than aluminium bronze, and about the same as for a high-tin bronze. The distribution of the metal in the pouring gate and feeders should be

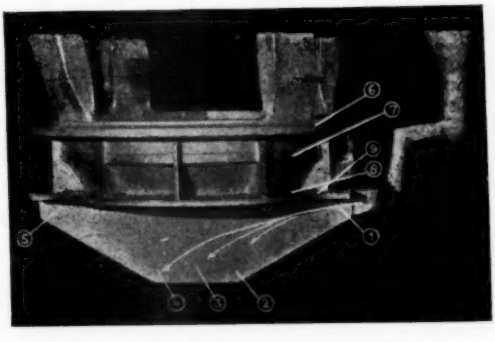


FIG. 9.—*Example of a Beryllium-bronze Casting showing the Location, Size, and Distribution of Runners and Risers.*

TABLE VIII.—*Joint Effect of Impurities on Mechanical Properties.*

Composition, per cent.	Heat-treatment.			Mechanical strength.			
	Quenching.	Tempering		Ultimate tensile strength, kg. per sq. mm. (tons per sq. in.)	Elastic limit, kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.	Brinell hardness.
		Temperature, deg. C.	Duration, hr.				
Be = 2.10 Mg-traces Ni = 0.25 Ti = nil Fe = 0.16 Sn = 0.01 Si = 0.02 Zn = 0.005 Al = 0.05 Pb = 0.007	After 1 hr. at 720 deg. C.	300	4	94.3 (58.4)	82.9 (52.6)	2	320
			6	101.5 (64.5)	93.7 (59.5)	1.5	340
		320	4	107.5 (68.2)	107.5 (68.2)	0	363
			6	114.0 (72.5)	114.0 (72.5)	0	363
Be = 2.23 Mg = 0.29 Ni = 0.25 Ti = 0.02 Fe = 0.12 Sn = 0.02 Si = 0.16 Zn = 0.03 Al = 0.13 Pb = 0.007	After 1 hr at 720 deg. C.	300	4	89.6 (56.8)	89.6 (56.8)	0	325
			8	97.0 (61.5)	87.5 (55.6)	1.0	350
		320	4	100.5 (63.9)	96.3 (61.0)	0	365

TABLE IX.—*Influence of Aluminium on Mechanical Properties.**

Percentage composition: Be = 2.0, Fe = 0.09, Si = 0.27, Mg = 0.40, Ni = 0.31, and Al = 0.10.

Duration of soaking.	Quenching Temperature, deg. C.	Mechanical strength.			Remarks.
		Ultimate tensile, kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.	Brinell hardness.	
1 hr.	750	66.4 (42.2)	0	357	Normal appearance
,, ...	780	49.7 (31.6)	0	326	,, ,,
,, ...	800	Sample broken by hand	Sample broken by hand	Sample broken by hand	,, ,,
,, ...	810	,, ,,	,, ,,	,, ,,	,, ,,
,, ...	820	,, ,,	,, ,,	,, ,,	,, ,,
,, ...	830	,, ,,	,, ,,	,, ,,	"Burned" appearance

TABLE X.—*Effect of Increasing Tempering Temperature on Mechanical Properties.*

Quench (after 1 hr.)	Temperature (6 hr.), deg. C.	Ultimate tensile kg. per sq. mm. (tons per sq. in.)	Elastic limit, kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.	Brinell hardness.
720 deg. C. ..	280	88.4 (56.2)	69 (43.7)	2	273
	300	101.5 (64.5)	93.7 (59.5)	1.5	339
	320	114 (72.5)	114 (72.5)	nil	363
	340	110 (70.0)	115 (73.0)	nil	372
800 deg. C. ..	280	103 (65.2)	89.5 (56.8)	1	321
	300	111 (70.8)	105 (66.8)	1	339
	320	115 (73.0)	110.5 (70.3)	0.5	361
	340	115 (73.0)	115 (73.0)	nil	393

suitably adapted to prevent microporosity and consequent brittleness (Fig. 9, Table XIV).

The development of microporosity in a round bar (50 mm. dia., 250 mm. long (2 in. by 10 in.)) cast horizontally through an ingate at one end depending on the profile (truncated cone) of the feeder and the casting temperature, as illustrated by Fig. 10. The use of feeding heads with a "heel" as shown in Fig. 11 is advisable, and certainly advantageous if the following conditions be observed:—

* See correction at the end of the discussion on page 325.—Editor.

TABLE XI.—*Effect of Mould Material on Properties Shown.*

Material of mould.	Mechanical strength.					
	Metal as-cast.			Metal hardened and tempered.		
	Ultimate tensile, kg. per sq. mm. (tons per sq. in.)	Elastic limit, kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.	Ultimate tensile, kg. per sq. mm. (tons per sq. in.)	Elastic limit, kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.
Green-sand	52.9 (33.5) 53.0 (33.6)	40.8 (25.9) 29.6 (18.4)	14.0 16.0	96.0 (61.0) 95.9 (60.9)	82.7 (52.5) 82.7 (52.5)	1.5 1.5
Skin-dried sand	52.5 (35.4) 52.9 (33.5)	28.6 (18.2) 27.2 (17.3)	16.0 17.0	95.9 (60.9) 97.0 (61.5)	84.3 (53.4) 82.1 (52.2)	1.5 1.5
Stoved-dried	52.3 (33.2) 51.8 (32.9)	30.0 (19.0) 29.3 (18.6)	17.0 19.0	— 97.8 (62.0)	— 81.5 (51.7)	— 1.5
C.I. chill	53.0 (33.6)	33.0 (20.9)	10	—	—	—

The ingate leading from the head to the mould should have a cross-sectional area exceeding the greatest thickness of the casting at the nearest point; the feed head should be not less than 80 to 100 mm. (3 to 4 in.) high, and the molten metal should be fed to the mould at the lower end of the head and on the side opposite from the casting.

This arrangement has a number of advantages, which can be summed-up as follow:—

It enables, as far as possible, the establishment of a rising temperature gradient between the most distant point of the mould, and the feeding head, which is the ideal condition for obtaining sound castings; the rotary motion imparted to the molten metal enables all scum and oxide skin to be concentrated in the feeder head; the metal enters the mould without any kinetic energy, which is an advantage in many ways, and particularly if the mould has intricate parts or fragile cores; and fettling is easier.

Chills.—The "chills" used can be of cast iron, wrought iron, steel or pure copper. The last behave very well, even if without dressing, in contact with the bronze, at least up to 1,150 deg. C.

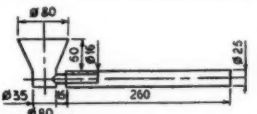
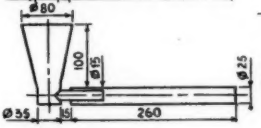
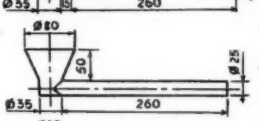
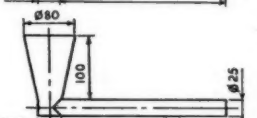
Remelting runners and feeders.—It is necessary carefully to remove any sand adhering to sprues, gates or feeders, before remelting, since silica reacts with beryllium above about 1,200 deg. C.

Conclusion

Beryllium-bronze provides a link between the general properties of the bronzes and of steel; furthermore, it pours and casts particularly well; finally, it can be made very hard (after quenching), and easily machinable (as cast, or annealed), and has high mechanical strength.

By virtue of the other properties of this alloy, of which may be mentioned: high heat- and electrical-conductivity, non-magnetic property, low coefficient of friction on steel, high abrasion resistance, absence of sparking when struck, a number of openings are offered for the use of beryllium-bronze in electrical construction (contact points, etc), mechanical engineering (gear-wheels, bolts, bearings, hubs, valves, elements in frictional contact, etc.), the plastic industry (moulds); as well as in mines, petroleum refineries and explosives factories (tools, grinders and mixers, and the like).

TABLE XII.—*Influence of Mould Arrangement on Mechanical Properties.*

Mould arrangement (dimensions in mm.)		Casting temperature, deg. C.	
		1,050	1,150
		Ultimate tensile, kg. per sq. mm.	Ultimate tensile, kg. per sq. mm.
	(a)	24.2 (15.3)	58.8 (34.1)
	(b)	40.2 (25.5)	57 (36.2)
	(c)	42.9 (27.2)	77.3* (49.1)
	(d)	60.0 (38.1)	85.2* (54.0)

* Only in mould arrangements (*c*) and (*d*) was any measurable elongation recorded—0.5 and 1.0 per cent. respectively for bars cast at 1,150 deg. C.

TABLE XIII.—*Mechanical Properties of an 8-in. Spanner Casting.*

	Mechanical strength.		Elongation, per cent.
	Ultimate tensile, kg. per sq. mm. (tons per sq. in.)	Elastic limit, kg. per sq. mm. (tons per sq. in.)	
Heads (6 samples) ..	80 to 90 (50.8 to 57.0)	75 to 85 (47.6 to 54.0)	1.5 to 4.5
Shank (6 samples) ..	81 to 101 (51.3 to 64.2)	77 to 93 (48.9 to 59.0)	1 to 4.5

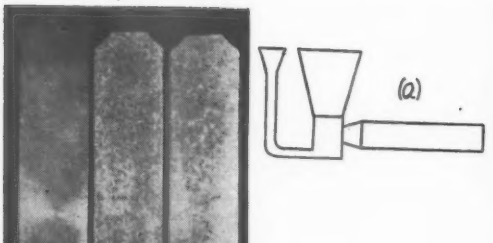


FIG. 10.—*Macrostructures showing Development of Porosity according to Casting Temperature.* FIG. 10 (*a*) *shows the Ingate Design used for Bars* 2 *and* 3 *and* FIG. 10 (*b*) *the Design for Bar* 1.

TABLE XIV.—*Mechanical Properties According to Casting Condition.*

Sample shown in Fig. 9.	Mechanical strength (untreated metal). Ultimate tensile kg. per sq. mm. (tons per sq. in.)	Elongation, per cent.	Remarks.
1	Failed in machining		Dendritic crystallization
2	31.5 (20.0)	7.1	
3	29.9 (19.0)	5.3	Slight dendritic crystallization
4	17.5 (11.1)	nil	Dendritic crystallization
5	34.9 (22.1)	10	
6	42.9 (27.2)	28.6	
7	42.5 (27.0)	27.5	

DISCUSSION

MR. F. HUDSON, who had presented this Paper at the Conference on behalf of Mr. Grand, who was unable to be present, said he was proud and privileged to read the contribution, but it was rather embarrassing because so few British foundrymen knew much about beryllium-bronze.

In moving a vote of thanks to Mr. Grand for the Paper and to Mr. Hudson for reading it, MR. F. C. EVANS said there was a very limited production of beryllium-bronze in England. He had been surprised that the cobalt/beryllium alloy had not been mentioned, particularly as it had similar properties for sand casting. One foundry in the London area made castings of this alloy, but production was low because of the shortage of metal. The vote of thanks was endorsed with enthusiasm.

MR. D. C. G. LEES wrote that this Paper was of considerable personal interest because he was at one time engaged on experiments with beryllium in aluminium alloys. Nobody told him at the time that there was any danger in beryllium, and when any of the metal was needed, he sawed a piece by hand from a lump, of German origin, which was carefully kept in a safe. After nine years he was still alive and wondering how he escaped the various troubles about which he had since read.

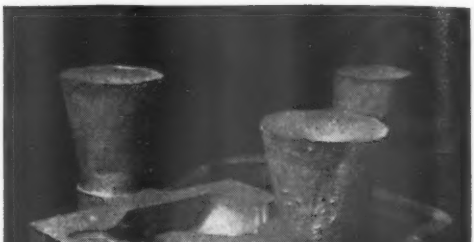


FIG. 11.—*Use of Feeding Heads designed with a "Heel" for a Beryllium-bronze Casting. Running is arranged through the Feeders.*

Beryllium was an element with a great affinity for oxygen, and it could be used to prevent the magnesium contained in some aluminium alloys from reacting with moisture in the mould, thereby preventing unsoundness due to hydrogen absorption after pouring. This beneficial effect was due to the formation of a thin continuous film of beryllia on the surface of the molten metal, which prevented the oxidation of the magnesium. Could Mr. Grand indicate what the surface of molten beryllium-bronze was like? Did it in any way show the obvious surface skin of aluminium-bronze? Further, what was the appearance of the castings on stripping? Were they black, like a tin bronze? In aluminium/magnesium alloys, a variety of colours was found according to the beryllium content, ranging from lilac to grey.

Gas Unsoundness

On page three of the Preprint Mr. Grand gave his findings about gases in beryllium-bronze, and he (the writer) would like the Author's views about the origin of this phenomenon. No trouble seemed likely from reaction unsoundness because this was generally associated with oxygen, which one could hardly imagine existing along with beryllium. Presumably, then, the "spitting" mentioned was due to hydrogen, and it sounded as if the solubility of this gas was higher in beryllium-bronze than in other copper alloys.

Lastly, he inquired as to whether iron had any appreciable influence on the alloy. In some work on beryllium in aluminium alloys there was a suspicion that iron was concerned by reason of its formation of an intermetallic compound with beryllium. Could M. Grand clarify the critical amount

of aluminium which gave increased brittleness, Table IX gave 0.10 per cent., while the text of the Paper mentioned 1.0 per cent. ?

MR. GRAND, in reply, wrote:—

Toxic Properties of Beryllium.—So far as this was concerned, he could not cite one single accident due to the handling of this metal, where its alloying with copper (beryllium-bronze) was concerned. He knew, however, of one death attributable to beryllium-fluoride. That was why in the Paper it was necessary to warn members, if not against beryllium and its alloy, at least against its salts.

Surface Appearance.—In the case of molten beryllium-bronze, no film of oxide was formed comparable with that of aluminium-bronze and no moulding troubles were encountered as was the case with aluminium-bronze. Beryllium-bronze castings carried an "old-gold" tint, midway between that of bronze and brass. Sometimes there appeared, for no apparent reason, black-coloured areas on some parts of sand castings just after stripping, but it was invariably only a very superficial coloration.

"Spitting."—With the exception of a case where the spitting noted coincided with a fall in the stream of the metal from a fairly high level, which had caused an entrainment or perhaps an emulsion of air in the metal, spitting was unusual. No spitting had been observed with later moulds correctly cast with the same metal. The gassy beryllium-bronze castings referred to in the Paper had been made up from oily or moist scrap and the spitting observed was indubitably to be attributed to the difference in the hydrogen solubility of beryllium-bronze at melting and solidifying temperatures.

Iron Content.—Within the range of iron content in the beryllium-bronze which the Author used, and which had never been in excess of 0.50 per cent., he had been unable to note any real influence of this metal on the static mechanical properties of the bronze cast in sand. On the other hand, he had never had to worry himself as to the actual influence of the iron content on the fatigue values and could give no opinion on that subject. In any case, and invariably for iron contents of less than 0.5 per cent., the macrographs and micrographs he had prepared had not led him to believe that acicular ferrous crystals were present, which in such a case would be capable of setting up a certain amount of brittleness in the metal.

A Correction.—The discrepancy pointed out by Mr. Lees, as to the amount of aluminium, came from what, because of the absence of any indication in the French text, would appear to be an error in the translation to English if Table IX referred to this impurity. Actually Table IX meant to show the influence of magnesium. The Author had noted a case of burning at 800 deg. C. on beryllium-bronze containing about 1 per cent. of aluminium. However, systematic research on the influence of this element had so far not been carried out.

Indian Steel Plans

Mr. Ernest E. Swartswelter, head of an American firm of steelmaking equipment manufacturers, recently met Mr. Chintaman Deshmukh, Indian Finance Minister, and Mr. G. L. Mehta, member of the Planning Commission, and discussed with them India's plan for increased steel production. Mr. Swartswelter, president of the Aetna-Standard Engineering Company, Pittsburgh, Penn., was accompanied by Mr. Albert O'Connel, who is to stay in India for some time.

Their visit to India was undertaken, according to "Indian Trade and Industry," at the instance of their Japanese associate firm, the Aetna Japan Company, to which may be entrusted the proposed erection of a blast furnace at Sambalpur, in Orissa, should negotiations between the Government of India and Japanese steel-producing interests reach successful conclusions.

The Japanese proposal entails the construction of a railway line from Sambalpur to Calcutta for the transport of pig-iron, and, it is reported, the Railway Minister is yet to be satisfied that the proposed line will be economically sound. Even if the Indo-Japanese negotiations fail, it is believed that the Aetna-Standard Engineering Company will still be interested in India's plan for increased steel production. Mr. Swartswelter was of opinion that a World Bank loan to India appeared certain, and the prospect of American capital participating in an Indian steel enterprise was not ruled out.

The Indian Finance Minister, Mr. Chintaman Deshmukh, said in the House of the People that negotiations with the World Bank were "imminent" for a loan in connection with the iron and steel projects.

U.S. and Canadian Statistics

The 40th annual statistical report of the American Iron and Steel Institute presents statistics relating to the iron and steel industries of the United States and Canada in 1951, together with comparable figures for some preceding years. Figures showing the production of coiled baling wire and alloy steel ingots containing boron are now given, and also published in the report for the first time are figures showing the consumption of liquid petroleum in heating and annealing furnaces.

The Canadian figures cover pig-iron and steel production and materials consumed in the manufacture of pig-iron, the output of finished steel products, consumption of coal and coke in the various processes, fuel-oil consumption, and fluxes used in steelmaking furnaces. Other tables relate to production, imports, and exports of coal, coke, and iron ore.

Record Pig-iron Output

Latest steel and pig-iron output figures (in tons) compare as follow with earlier returns:—

	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1952—July ..	201,600	10,482,000	273,800	14,236,000
August ..	201,900	10,498,000	279,500	14,535,000
1st half year	199,900	10,397,000	308,600	16,046,000
1951—July ..	182,400	9,484,000	256,100	13,317,000
August ..	180,900	9,409,000	266,400	13,855,000
1st half year	182,800	9,506,000	313,600	16,306,000

Scabs—Their Cause and Cure*

By P. Nicolas

Definition.—The foundry defect known as scab (*galle*) is characterized by metal penetration beneath a thin wall of sand partially detached from the mould.

Cause.—A scab is due to the rapid expansion to be associated at 573 deg. C. with the transformation of the silica from alpha-quartz to the beta-quartz phase. The corresponding expansion is great, something of the order of 1.5 per cent.

Formation of Scabs

Recent observations made on this subject indicate that the defect usually occurs in the upper surface of flat castings, especially of certain thicknesses. The breakdown of the mould, which is the cause of the defect, always occurs when the affected surface is exposed to high temperature before making contact with the liquid metal. Scabs occur chiefly when working with "green" sand, although casting in dried moulds does not necessarily eliminate the defect.

When pouring in a green-sand mould, the sand on which the metal spreads out, dries out to a depth of about 3 to 5 mm. Because of the low conductivity of this crust of dry sand, the drying of the part of the mould immediately behind is distinctly slower. The temperature of the dried layer, therefore, mounts up quite rapidly and if the dry sand is too rigid it cannot withstand the expansion and cracks. At each side of the crack so produced, the sand is forced outwards and thus forms the lips, which are noticeable on the majority of scabs. These concentrate at certain points on the surface of the mould, because of the displacement of the layer of dried sand as it rests on "green" sand which shows some plasticity. In the case of stoved work, the mass of the sand is, taken altogether, more rigid; one can therefore visualize the appearance of a large number of small cracks in the surface, but the sand does not become so deformed as to produce the deep depressions on the surface of the casting characteristic of scabbing.

Reasons for Scabbing

Conditions which allow of the creation of stresses in the mass of the sand, due to the expansion of the silica content are the basic cause of scabbing, associated with the rigidity of the rammed sand; the more rigid the sand the more likely it is to scab. What follows is a brief description of sands liable to cause scabbing.

1. *Sands of fixed composition.*

(*a*) Sands of regular grain size (that is why the more frequent appearance of scab is noted when moulding in synthetic sand than in natural. The latter often shows a less regular grain distribution and always contains a certain amount of fines, which operate against a very dense packing of the grains.

(*b*) Sand having a very high content of fines (which literally close up the spaces between the silica grains).

2. *Compact sands artificially produced.*

(*a*) Due to ramming too hard or unequal or incompetent smoothing.

(*b*) Sand more moist than normal, offering a greater "green" deformation and yielding a more tightly-rammed mass.

3. *Sands showing rigidity at the elevated temperature of casting.*

(*a*) As the temperature rises, the clay contracts, whilst the silica expands (this factor is the basis of the making of refractory monoblocs); the leanest sands are therefore the most liable to scabbing.

(*b*) The nature of the fines in the sand can assume real importance, because:—

A. silica fines conform to the same expansion laws as the grains of silica (they thus encourage the appearance of scabs);

B. some dense mineral fines such as powdered graphite are without notable influence, as they expand little;

C. elastic mineral fines, such as asbestos flour, are worthwhile additions as an aid to the elimination of scabs; and

D. fines of organic origin (wood-flour); starch products or coal-dust prevent scabbing as they contract at high temperature.

Cures for Scabbing

As one is unable to do anything about the expansion of silica, it is necessary to utilize the aptitude of the sand of which it is the main constituent so as to make it neutralize the effects of expansion:—

A. The usual remedy consists of reducing the time of the exposure of the sand to the heat by an increase in the speed of teeming, through an increase in the sizes of the running system.

B. The second cure consists of using a sand susceptible to a certain amount of hot-deformation, having a wide range and not a concentrated size of silica grains; a reduced quantity of silica fines (maximum 0.8 per cent.); addition of elastic mineral fines or, better still, organic fines (or starch products (Mogul)) or wood-flour to an extent ranging between 0.5 and 1.0 per cent. and coal dust to usual amount of 3 to 4 per cent. can be used.

Effect of Other Properties

1. *Green-plasticity.*—Sands showing high plasticity are especially subject to scabbing as they ram-up very closely.

2. *Green-strength.*—It has been proved that sands liable to promote scabbing are those showing low green-strength. This is simply due to the clay content of the sand being insufficient not only to confer upon it strong cohesion, but also to allow an adequate contraction to counterbalance the expansion of the silica.

3. *Permeability.*—Scabbing appears above all in low-permeability sands, but this is due to the make-up of the sands; a percentage of fines has been shown to be deleterious from the expansion angle.

4. *Hot-strength.*—Scabbing comes about whenever hot-strength of the sand is high. This is particularly the case with very damp sands of which the hot-strength is from this fact materially increased. It is likewise the case with sands rich in silica-flour which, as has been shown, improves the behaviour of the sand at elevated temperature.

For the same reason, organic materials play a beneficial part, above all on account of their contraction during drying, followed by a production of voids as their destruction comes about more or less quickly under the effect of the heat.

* Translated from *Fonderie.*

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Time and Motion Study*

Discussion of Mr. C. D. Hunter's Paper

MR. HUNTER prefaced his Paper on time and motion study with the remark that for the purposes of clarity he had made reference to the function of several departments in operating the techniques described. Large companies would have those departments already constituted, but just because a particular company might happen to be small, it should not be thought necessary to have large departments and inter-connections. In a small company the practice very often was to invest those departments in one individual. Founders should not say, without due consideration, "We cannot afford it"; they should pause, reflect and consider whether they could really afford to do without it.

[After reading the Paper Mr. Hunter showed a film by General Motors, Limited, on the subject of motion-study.]

Application to Foundry Administration

THE CHAIRMAN (Mr. W. H. Davies, C. & L. Hill, Limited) said it was perfectly clear that there was more to the production of a casting than the mere making of it. In the book "What is this Management?" the Author had pointed out that the leader, the foundry director or manager, had within himself a triple content: first, there was the technological content; second, the content of the man himself and his personal qualities, without which no man could remain long in leadership, and the third content was organizing and administrative ability. Just as practical foundrymen, with their wealth of technical knowledge, were aware that they must have the right tools, so the Productivity Team was asking founders, when they returned to their respective firms, to impress upon their fellow executives and on the foremen and the charge-hands, the belief that administration required special tools, such as those about which they had been hearing.

MR. EDGAR N. HILEY (National Brassfoundry Association) said the N.B.A., formed a long time ago, under the rather oppressive title of The Brass Masters' Association, was mainly for the purpose of conducting negotiations with labour. In fifty-six years of such negotiations the industry had never known a strike, which he believed to be due very largely to the fact that the family spirit had remained in the industry and that most of the firms were of a family nature. In the course of compiling a history of the trade he had discovered that in the so-called "bad old days" of a six-day week and goodness knows how many hours, the old brass masters quite frequently went into the works at 7.30 on a Sunday morning to teach their uneducated employees the elements of the three R's; it was doubtful whether there was quite so much enlightenment among modern employers.

Plea for Improved Relations

Reference had been made to profit-sharing, and the previous night he had paid a visit to a former president of the Association who had told him that his firm's profit-sharing bonus, which increased according to the years of service, this year meant that all workers who had served more than ten years with the firm had their wages doubled. The firm was most efficient, and represented one of the most outstanding units in the trade. Moreover, every single member of its Board had risen from the very lowest rank, and in his view that sort of thing was the answer to the subversive forces which were beginning to undermine the industry. It was true that there were certain extreme examples where consultation was being carried to such a remarkable degree that the whole firm seemed to be one mass of committees. Those firms had probably over-elaborated somewhat, but at the same time Mr. Hunter had been right in pointing out that all the know-how in the world was as nothing if the management of a firm was not on proper terms with the workpeople.

MR. R. H. CLEAVER, speaking as a union official for the Birmingham, Wolverhampton and Black Country area, said he had been most interested in the Conference, both from an educational point of view and also from the point of view of the films which had been shown. British operators had a reputation of not forgetting the "bad old days" as they were now called, but on the other hand they did not want the American way of life. The British nation was entitled to mould its own way of life, and they should use their initiative to bring that about. If they had an incentive and all pulled together then there was nothing which the various systems of consultation could not achieve.

Mr. Hunter's Paper on time and motion study should be kept in perspective, and several trade unions were sending officials to take up the subject and find its correct place in industry. As long as that was done in a humane way everybody would be satisfied. There had been some managements who used time-study unfairly in the past and that was a fear which would have to be taken away from operators. In measuring speeds of working it should also be borne in mind that sooner or later technicians would be able to give some idea of how to measure effort as well as times and speeds.

Small Firms

MR. RUTHERFORD (British Non-Ferrous Metals Research Association) said no-one could argue against the fact that for successful competitive business it was essential to know how much

*Paper presented to the Brassfoundry Productivity Conference and printed in the JOURNAL, August 28, 1952.

each product was costing, so that it could be marketed with a reasonable margin of profit, but he wondered how far the processes of time- and motion-study could be taken in the smaller firm, and particularly in the bronze foundry industry, where the proportion of establishments employing fewer than one hundred men was very large, and where he suspected the cost of any extensive scheme along the lines of those which had been described by Mr. Hunter might far outweigh any economic advantage to be gained.

Most of the descriptions one heard of processes for determining methods and measuring times taken were in connection with engineering work, and there was probably a good reason for that. Taking lathe turning as the simplest example, the timing was controlled principally by the speed of the machine and the feed and the depth of the cut, and, naturally, by the material. All those things were mechanical and of a sort which could be fixed by adjusting the machine and from a knowledge of the material, but when it came to foundrywork, such as the setting of cores in a mould, he imagined jobs could not be assessed from one to another in anything like the same way because the size of the cores and their positions varied.

MR. C. D. HUNTER, replying, assured members that quite small companies of less than fifty employees had received very great benefit from the techniques of time- and motion-study, and in foundries of all types, both ferrous and non-ferrous, the techniques had been applied with great advantage.

Speeds and feeds and such like for capstan lathe or any other machine operation were not timed: that data was only checked to see that it was correct. To give one simple example, a planing machine might feed at 100 ft. per min. and have a return stroke of double that, but if there were four tools in that planer it would not cut at one hundred feet a minute; its effective cutting speed would be something of the order of ninety. Therefore it was important that such data should be clearly recorded. The more significant part was the timing of the contributions made by the operator. In foundrywork it was the collection of data, for instance, for all types and sizes of cores, which mattered, and the compilation of the results into a form which could be used equitably and fairly.

Incentives and Allowances

MR. A. H. SQUIRE said in the reference to the need for providing adequate incentives he was surprised that no mention had been made of the need for providing an incentive for the skilled man to undertake supervisory responsibility.

MR. A. N. WORMLEIGHTON, in reply, said that the question of awards to supervisory personnel was a very real problem and it was very necessary that an attempt should be made adequately to arrange encouragement to men with the best brains to take up the position of foreman. It was difficult to define what precisely would fit every case, but it was certain that a review would have to be made of methods for providing such incentives, if full advantage was to be taken of present-day techniques and knowledge.

A MEMBER said his firm was at the present time in the stage of installing a time- and motion-study, but he was still dubious about one particular point in so far as they obtained a fatigue allowance for the various operators and a standard fatigue allowance. He could not see how a fatigue allowance was applicable to an operator who was perhaps first carrying out subsidiary operations to a particular component on a machine, then, later, the component required a rather long operation of, say, traversing on a machine, and after that the machine was stopped and the particular piece was taken down and another one inserted and the operations repeated.

MR. HUNTER said the fatigue allowance applied to the portion of the operation where the operator made a contribution, and that must not be standard all the way through the process and was not standard for different types of operation. Some people made the mistake of saying that a fatigue allowance should be 10 or 15 per cent., but there was in fact no exact way of determining fatigue; it was one of the things which required a great deal more investigation and consideration. Much research had been done and medical practitioners had been consulted. Over the course of 40 years in his own company in the United States and 20 years in this country, certain allowances had been arrived at. These particular allowances were made as a compensation for normal effort, so that next morning the operator went to work completely refreshed and therefore was not fatigued indefinitely.

WRITTEN COMMENT

MR. R. A. SKINNER wrote that there were three points that he would like to make in connection with Mr. Hunter's paper. First, how did Mr. Hunter determine how hard a man was working when he was being timed for standard-time purposes—was there not a tendency for the man to work a little slower? Also, in evaluating standard times from the measured times, Mr. Hunter made use of a "rating factor," which was an estimate by the time-study man of the operating efficiency. This rating factor would seem to be very liable to personal error which would, in turn, lead to errors in the standard times calculated on these figures.

This brought forward a point which to his mind Mr. Hunter did not emphasize sufficiently. Unless the time-study man had sufficient character to earn and retain the confidence and trust of the workers in himself and his methods, the system would not work efficiently, if at all. Likewise, the management must not, having once fixed the rates, alter them without good reason and the agreement of the workers. Any "fiddling with the figures" would destroy confidence and stop the system from working.

MR. HUNTER replied that it was first necessary to be quite clear that it was sought to establish elemental time data for elements of work and not

a complete operation. For example, they set out to determine the time required for a normal operator to perform such elements of work, for instance, as placing the moulding boxes, the loading of the moulding box with sand, the setting of the pattern in the moulding box, ramming the pattern and so forth, for a wide range and size of moulding box and pattern.

Furthermore he quoted "For studies to yield correct time-values for the elements of work, it is necessary that a true cross-section of shop operations and workers should be time studied." This meant that different time-study observers would study similar operations in which the same element recurred with great frequency. The operator's performance was rated for each element of work. Again, "The object is to establish a time for a normal operator working in normal conditions." It would be appreciated that accurate rating, which was of the greatest importance, could only be achieved by the observer after considerable practice and experience. Even when this was acquired, it was necessary to keep in practice and check against a standard so as to maintain uniformity of rating between different time-study observers and for any one time-study observer at different times. To provide this uniformity, certain standardized tasks were used, for example: (1) peg board; (2) washers and pin, and (3) card dealing. On all of these tasks, thousands of observations had been made and timed by the company to arrive at what constituted a normal pace which was called 100 per cent.

Practice runs were made with these tasks at varying rates of performance. Time-study observers rated the performance in stages of 5 per cent. above or below 100 per cent. Their ratings were then checked against the time recorded for each performance. This was continued until observers were able to rate consistently within 5 per cent. This factor was applied to a given elemental time and, during the course of the time-study work, a vast number of rating factors and elemental times were recorded for the same element of work before the final selection was made.

Internal Co-operation

Regarding the second point, he quoted:—

1. "The approach to the operator is made through the foreman, and the operator is kept fully informed as to what is taking place. His interest is sought and his questions answered, and every attempt is made to secure his co-operation and collaboration."

2. "Times can be issued . . . but so far as the operator is concerned a copy of each Standards Computation Sheet is always available for reference, to ensure that the method employed follows exactly the method for which the production standard has been established."

3. "In conclusion, time-study depends for its effectiveness upon a fair and honest approach by management and worker."

If the matter was approached and established on this basis and with these principles in mind and all information was made available to the operators as indicated, he failed to see how anything but good management could result.

MR. RUTHERFORD (B.N.F.M.R.A.), wrote that in addition to the questions he raised during the verbal discussion there were one or two other points he had in mind:—

1. Since it was necessary for a large proportion of the standard time for a job to be based only on estimates, *e.g.*, rating factor, fatigue allowance, (monotony, eye-strain), personal needs, "extra allowances" (faulty equipment), and since the performance of the operators was no doubt affected by being under observation, why was there such great insistence on the accuracy of elemental times? Such estimates must be more unreliable for jobbing foundries making one or two off from very different patterns than for repetition machine work.

2. Of what value were elemental times in a jobbing foundry of this type, where he imagined, for instance, the time to set a particular core in a particular mould must be widely different from that for another core and/or mould, so that measurement for a host of different cores must be necessary? Thus, there may be an insufficient number of a particular core type to allow an accurate elemental time to be measured and fresh measurements might be needed each day.

3. How many operators was it considered necessary to observe so as to obtain a reliable elemental time for the average operator and how was the rating factor of the operators fixed, again bearing in mind the effect of observer on the observed and the variety of psychological reactions?

4. Were there any simpler alternatives to the schemes described by Mr. Hunter which, while not being so accurate or comprehensive, might at least be adequate for the smaller foundry?

5. The ways in which standard costing methods could aid productivity were not stressed at the Conference, and if Mr. Hunter could enlarge on this point, he thought it would be useful.

Author's Replies

MR. HUNTER replied severally to Mr. Rutherford's points as follow:

1. This question required grouping:—

(*a*) *Rating* was an assessment made by the observers but was controlled to a datum as explained in a previous reply.

(*b*) *Fatigue and personal needs* were standard allowances given according to the conditions obtaining when the studies were made. They had been determined by study work carried out by a vast number of engineers over a period of 40 yrs. in America and 20 yrs. in Great Britain, and could, therefore, by no stretch of imagination be described as estimates. The above were the factors which were taken into consideration when the standard data were compiled—data which would be used for all future operations and without further study work being necessary.

(*c*) *Extra allowances* were given to compensate the operator when non-standard conditions arose and were intended to cover a given batch of work only. Under good management, this condition

Time and Motion Study—Discussion

would be removed before a further batch of works was put into operation and no further extra allowance would be necessary.

Initial Effort Worthwhile

2. If the products which were made in a jobbing foundry were grouped and classified intelligently and within these groups the operations were clearly defined, and then elements of work determined within each operation, it would be astounding to observe the frequency with which a given element repeated itself. In this practice of building up synthetic or standard data in graph or tabular form, the required study work was intensive in the first instance but was far less than that which would be required by any other method, as it obviated study work for new jobs once the data was compiled. It was more accurate and satisfactory in practice as the same basic data was used to establish production standards for all subsequent jobs. In this connection it would be appreciated that it would be of inestimable value in the jobbing foundry.

3. As many operators as possible were studied by as many observers as might be practicable. (The method of assessing the performance rating had been described in a previous reply.) This rating factor was applied to the corresponding elemental observed time and the result was normal time (*i.e.* the time for a normal operator working at normal pace) under normal conditions and with the tools and equipment prescribed. He referred to the possibilities envisaged on an industrial basis: "Imagine ——— standard or 100 per cent."

Special Applications

4. (*a*) The management of some companies preferred to introduce a "Rowan" plan of incentive payment rather than compile elemental time data, where work was extremely diversified.

(*b*) Job evaluation could be applied to all grades of labour and could effectively be extended to include all staff grades. Thus the correct differentials were established as a basis for wages payment. This practice could be extended to form the basis of a profit-sharing plan, if a given proportion of the profits was set aside for the purpose and applied pro-rata.

5. Within an industry, a standard method of cost-control could materially assist cost comparisons of melting losses, direct labour and direct expenses involved in various processes, so that the best method of melting or other practice might be determined by equitable comparison. Company management was provided with pertinent information, as product costs were compared with sales or market values. Thus attention was directed to the profit potential of each product group and sales policy was formulated to obtain the required volume of the more favourable groups. Hence production was materially assisted by management's planned policy and the control of indirect expenditure was facilitated for all activities of production.

Cost consciousness was created in all levels of management and as a result the elimination of waste materials direct and indirect labour and shop supplies was a matter for immediate attention. The preparation of departmental operating statements and profit-and-loss accounts every four weeks provided management with valuable information in respect of the operations of all departments and facets of the business and pin-pointed places where corrective action was required. The extent to which productive workers achieved production "normals" was clearly depicted and all items of expenditure were measured against the predetermined budget in relation to the activity achieved for a period of four weeks.

Report on Remploy, Limited

The eleventh report of the session by the House of Commons Select Committee on Estimates, published last week, commented on the financial record and other aspects of Remploy, Limited. This concern has set up in all parts of Britain 92 factories in which, at the end of last year, it was providing employment under special conditions for some 6,000 disabled persons, including men who are employed in their homes on work for the company. The company is financed by public funds on the basis of direct payments to make good its trading losses and of loans to cover capital expenditure. The committee thought that the consideration of the undoubted and unquestioned value of the work which the company was doing for the permanently disabled had to a certain extent been allowed to overshadow the need for the most careful economy.

THE INSTITUTE OF BRITISH PHOTOGRAPHERS, 49, Gordon Square, London, W.C.1, have issued a brochure entitled "Photography in Industry." It is a report on the function of departments of photography and the training and qualifications of photographers. It carries four appendices and is priced at 5s.

Steel Economy in Building

The first of a series of bulletins on steel economy to be issued periodically to help those responsible for building and civil engineering work has just been published. Prepared jointly by the Ministry of Works, the Ministry of Supply, the Department of Scientific Research, and Service Departments, it deals with the design of buildings.

Pointing out that Great Britain has long-term difficulties arising from the balance of payments, since a large proportion of the iron ore and scrap required for the manufacture of steel is imported and additional supplies of foreign steel have had to be purchased, some for dollars and all at a high price, the bulletin states:—"To make our steel go further by economy in use will thus not merely tend to ease the present shortage, but will also have a direct beneficial effect on the balance of payments."

In future the Ministry of Works will examine licence applications for new buildings in the light of the recommendations of the bulletin, and will require a certificate from the architect or engineer that the recommendations have been fully taken into account.

Pattern Production Methods

By F. H. Wakeham

Various methods of producing a pattern can usually be found, but the quantity of castings to be made from a particular job often governs the method chosen. The example (Fig. 1) of a pump valve-box, shown in the section and plan views, may be a solidly-constructed pattern since it is comparatively small. The body can be built of four pieces of pine, two pieces on either side of the joint as shown in Fig. 2. The two pieces comprising each half of the pattern are glued and screwed together in the normal manner and then dowelled together.

The circular flange, X, Fig. 1, may be cut out of the main body, except that the full diameter has to

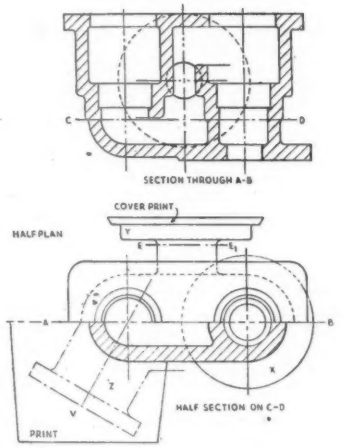


FIG. 1.—*Section and Plan View of a Pump Valve-box Casting.*

be made by adding extra timber at either side (Fig. 2). The rectangular flange and the pipe shown in the top-half of the plan, Fig. 1, are simple additions to the pattern body and need not be dealt with here. The flanged portion, Y, must be made loose, with, perhaps, a cover-print; the joint of the loose-piece being along the line, E-E, so that the complete half of the pattern above the line AB can be moulded in the cope only. If the cover-print were not used, the moulder would have to part down to the top of the flange and use a middle-part moulding box, and the cope would be used to take the print only. The print in this case would be a shallow cope-print of the diameter of the bore.

Branch Pipe

At least three methods may be used to make the 60-deg. off-set branch pipe, Z. One method is to dowell the body of the branch to the main part of the pattern (the dowells being perpendicular to

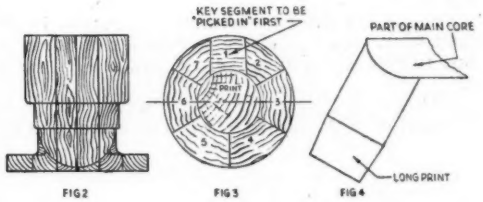
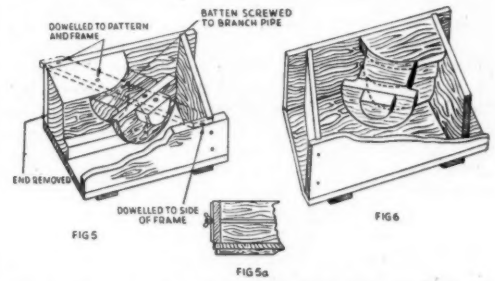


FIG. 2.—*Constructional Method for Making a Solid Wooden Pattern;* FIG. 3, *Segmental Assembly for the Branch Pipe, and,* FIG. 4, *Main and Branch-pipe Core Location.*

the pattern joint) and then arrange the flange, V, in segments around the pipe. The segments might include the fillet between the flange and the pipe or simply be left square, leaving to the moulder the job of working the fillet. Whichever method be used, one of the segments should be a "key" segment, (Fig. 3) and clearly marked as such, so that it may be "picked in" first when withdrawing the flange.

Another method of moulding the branch pipe is to dowell the pipe as described previously, but to arrange for the flange to have a cover-print, this to be moulded in the same manner as the flange, Y. The cover-print in this case should fit over the core-print which positions the core for the branch-pipe. The purpose of the longer print being so that the core will be well supported when set in place since the core will be lying at an angle of 60 deg. In such a layout, no studs need be used, especially when the main core is lowered, the convex portion of the main core resting accurately into the concave portion of the branch core (Fig. 4).

The third method of production is to core the branch-pipe. This method would not find favour if a few castings only were required, but for a large quantity, it would probably be the best proposition. It entails the use of a main core but the big advantage of making the branch pipe in



FIGS. 5 AND 6.—*Construction of a Corebox for the Branch Pipe.*

Pattern Production Methods

a core is that there is no tendency for the pipe to be rammed at all as may be the case in the two previous methods, since dowelling the pipe is not a good means of holding the pipe rigidly to the pattern whilst ramming. The shape of the core-print for the pipe is shown in outline in the plan view, Fig. 1, and the two halves of the core-box to make the full core are shown at Figs. 5 and 6.

Both halves of the corebox are made in a frame, the ends of which are bevelled to correspond to the

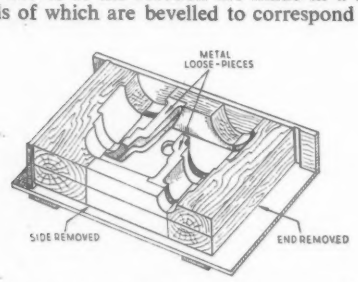


FIG. 7.—*View of the Main Corebox for the Pump Valve-box Casting.*

taper on the core-print. The frame is shown as screwed together, but for quick release of the core, bolts with wing-nuts may be used. One bolt at each end is usually sufficient. If absolute rigidity of the sides is essential, a piece of mild steel plate can be screwed to the side and extending practically the total depth of the side, (Fig. 5a). The wing-nuts work upon the steel surface, thus preserving the timber.

The branch-pipe part of the corebox shown in Figs. 5 and 6 is made separately from the pattern part, and is kept in position in each half by means of a batten which is screwed to the pipe portion and dowelled to the pattern and frame, thus keeping each part in its correct position whilst being rammed with sand.

The main corebox, Fig. 7, is also made inside a frame. Part of this corebox has to be made loose, since the thickness of metal around the bores follows the shape of the bores; and to release the core without making the parts as loose-pieces would be impossible. By making the pieces loose as shown, it is a simple matter to withdraw them once the corebox is turned over and the frame and other pieces are drawn away. They are simply withdrawn in a circular motion around the circumference of the bores. Such loose-pieces would be made in metal, since it is obvious that if they were of wood, they would be weak according to the way of the grain, and would tend to "spring" when being rammed.

J. W. JACKMAN & COMPANY, LIMITED, have sold 95 per cent. of their issued capital to Minerals Separations, Limited. Mr. W. R. Rawlinson will continue to act as managing director of the former concern.

New Catalogues

Fettling Bench.—K. & L. Steelfounders & Engineers, Limited, Letchworth, have prepared an eight-page leaflet which describes and illustrates a fettling bench with proper dust-extracting attachments. It is understood that the manufacture and sales of this equipment are to be undertaken by Molineux Foundry Equipment, Limited, of Marlborough Road, London, N.19.

Air Compressors. "Stationary Air Compressors" is the title of a high-grade well-illustrated catalogue recently issued by the Consolidated Pneumatic Tool Company, Limited, of 232, Dawes Road, London, S.W.6, yet (perhaps not unreasonably), a double-page spread at the very end of the brochure illustrates four models of portable machines. In the rest of the booklet, not only are the stationary models listed, but details of their construction and operating principles are given with commendable clarity. Foundrymen will find much to interest them in this brochure, which is obtainable on request to Dawes Road.

Shot-blasting—R. J. Richardson & Sons, Limited, Commercial Street, Birmingham 1, have used a folder to describe and illustrate the plant they have installed to provide their clientele with a 24 hours' shot-blasting service. From the pictures, it is shown that the equipment used includes machinery ranging from "rooms" down to cabinets, with rotating tables and barrel-type plants for medium-size work. Reliance is placed on the Wheelabrator rather than on compressed-air units. The firm's latest plant—that which incorporates auxiliary rotating tables let into a large rotary table—is not illustrated.

Fullers' Earth.—The Fullers' Earth Union Limited, Redhill, Surrey, have sent three pamphlets dealing with various aspects of natural fullers' earth and of its derivative, "Fulbond," as prepared for foundry use. The first of the series "The Properties of Fullers' Earth," details the fundamental constitution and properties of the mineral entity. The second on "Notes on Fulbond for Foundry Sands" methodically gives technical information as to the use of the material as applied to natural, or synthetic sands and coremaking. A number of other applications are also listed, such as, for mould- and core-paints and facings. The third leaflet, "The Moulding Properties of Fulbond at High Moisture Content," shows by letterpress and graphs much information quite helpful to founders. These useful booklets are available to our readers on writing to Redhill.

Cupola Instrumentation. The subject matter of an eight-page illustrated pamphlet received from Metronic Instrument Company, Limited, of Ettingshall, Wolverhampton is of primary importance to all founders having cupola installations. Wisely, the writer of this booklet asks why take the trouble to measure the coke, pig-iron and scrap changes, and neglect the most important of all raw materials—the blast. Thus the booklet deals with an equipment consisting of an inlet measuring pipe complete with an orifice disc and eddy correction grid. There is also included a motorized damper which does not interfere with flow measurement. The indicator has an electronic pilot control, which automatically regulates the damper to a predetermined flow value and incorporates a second finger for indicating the wind-belt pressure. Obviously, alternative arrangements are catered for. This booklet, which is available to our readers on writing to Wolverhampton, is factually written, but it is questionable whether the illustrations have been wisely chosen.

Incentives, Labour Relations and Good Housekeeping

Further Proceedings of the Brassfoundry Productivity Conference

A joint session to discuss working conditions in brass foundries was held at the Brassfoundry Productivity Conference organized by the Association of Bronze and Brass Founders and the National Brassfoundry Association. In the opening review, reasons for increased American productivity gleaned from many Reports were summed-up and their implications explained, with special emphasis on the need for proper costing. Next, Mr. Dewsbury, who was joint secretary to the Brassfoundry Team brought up-to-date the Team's findings in respect of manager/foreman/operator relations. Continuing this subject of amenities, there was included the application of dust-control to foundries generally, and brass foundries in particular, which derived from the classic work initiated by Mr. W. B. Lawrie of H.M. Inspectorate of Factories.

At the Wednesday morning session of the Brassfoundry Productivity Conference in Harrogate, Mr. W. H. Davies, B.Com., M.I.I.A., (of the Rubery Owen group) presided and the opening review was by Mr. A. N. Wormleighton (joint secretary, Brassfoundry Productivity Team), in which he dealt with the problem of incentives. Having lost his voice temporarily, Mr. Wormleighton was unable to address the conference himself, his talk was read on his behalf by Mr. L. H. Cleaver and the following has been abstracted.

Need for Adequate Incentives

By A. N. Wormleighton

It is probably true that the greatest single factor which leads to the high productivity as obtained in the United States, is the attitude of mind of all its people. They have become conscious of a very important fact—that only by greater production and higher productivity can they hope to establish an ever-increasing standard of living. An article by I. S. Lloyd which recently appeared in the South African *Journal of Economics* in connection with the report of 18 productivity teams, gives four conclusions, which he claims are established beyond the realms of controversy; they are:—

1. The productivity of industry in the United States, however measured, in output per man/hour, per head of the employed population or per unit of real resources invested—is substantially greater than that in any other industrial country in the world. This productivity is greater on the average over the whole industry, and it is greater in each specific industry so far examined.

2. While in most of the industries examined there are, in Britain, firms whose productivity is equal to, if not greater than, the best in the United States, the average in any British industry is well below the average in the United States.

3. The American economy is expanding and is increasing its productive capacity and efficiency at a rate which it will be difficult to match elsewhere. It possesses immense reserves of real resources of every kind and it is capable of maintaining and improving the considerable margin by which its real standard of living exceeds that in other countries.

4. The foundation of this great economic strength is the system of private enterprise which forms the economic philosophy and practice of the great majority of its inhabitants and which the Government of the United States has taken more pains to preserve in all its vigorous essentials than most governments in the western world.

He seeks for the answer in productivity reports for the reasons why the previous four factors have been created and he gives 11 points drawn up, as he believes, in order of importance: (*a*) The high quality of American management; (*b*) the competitive environment in which both management and labour live; (*c*) the visible improvement in his standard of life demanded by the average American (and his wife) and the fact that he is ready to concede to management the right to employ any methods, however personally inconvenient, which can be justified by the appeal to high productivity; (*d*) a widespread readiness to exchange technical and financial knowledge; (*e*) a general familiarity at all levels of management with statistics of all kinds, including the national and industrial statistics which are produced with such expedition by various private and public bodies; (*f*) good administrative organisation and techniques; (*g*) good workshop organisation and techniques; (*h*) the readiness of industry to encourage and of consumers to accept standardization and simplification; (*i*) the qualities and attitudes of American skilled and semi-skilled labour and of the unions which represent them; (*j*) certain features of the wage, taxation and industrial finance systems, and (*k*) good industrial relations. At this session of the conference, questions of labour relations, good-housekeeping, time and motion study, and standard costs are to be considered and at least seven of the headings enumerated demand these management techniques.

Why the Need of Greater Productivity?

The emergence of the re-armament programme gives the key to the first reason why greater productivity is essential—it is security. Secondly, the problem of the pressure of population of the whole world, together with a growing awareness that higher standards of living can be achieved by the peoples of undeveloped lands, creates in itself a

demand for higher productivity. Thirdly, in the narrowest field, greater productivity, together with visible improvement in the standard of living, is the only way which will raise western peoples from the generally lower standard as compared to the U.S.A.

The three reasons have been placed in a certain order but, in the long run, the last one is believed to be the most important. It is undoubtedly true that there is almost a vicious circle to break down before this essential change in attitude of mind can be brought about and, therefore, the proceedings of the present conference are appropriately arranged.

Costing

Finally, it is necessary that control techniques should include adequate knowledge and understanding of modern cost methods. Industry transforms raw materials into saleable products. This cycle is not completed until goods are bought and paid for by customers. To perform this transformation necessitates the application of labour and overheads. Although labour in its true sense is applied in purchasing, stores, office, engineering administrative sales, etc., the labour applied to the physical transformation of materials lends itself to the establishment of a common costing denominator over which contributory labour, management, fixed charges, and overhead expenses may be spread. The normal selling price must be greater than the combined costs of material purchases and the conversion costs, if a profit is to be made, and the control of conversion costs, or, in other words, controlling the expenses of producing and marketing the product, is the test of management.

The CHAIRMAN, congratulating Mr. Wormleighton on his able introduction to the proceedings of the session, said it would be agreed that he had written authoritatively. It was quite clear that his contribution was intended to attune the minds of his audience to what was yet to come. Next, he introduced Mr. B. G. Dewsbury (joint secretary, Brassfoundry Productivity Team), who presented his Paper on labour relations.

Labour Relations and Good Housekeeping

By B. G. Dewsbury

Before embarking upon the difficult and somewhat controversial subject of labour relations, the Author wishes to make it clear that the matter contained in the Productivity Report is based upon the Team's findings in the 22 American factories visited two years ago. The time is important, because a good deal has happened in the two countries during the intervening period. Furthermore, the remarks are not aimed at individual companies of the industry, some British firms are doing far more towards good labour relations than are their American counterparts; others, unfortunately, are doing far less. In spite of all British achievements and superlative craftsmanship, we are still lacking in the power to produce at the rate of the Americans; yet their methods of production do not account for the wide variance in production per man/hour of comparable jobs.

Perspective

The only way to see a picture in its true perspective is to stand well away from it. Members of the Team had that opportunity when from the new world they were able to look back upon the old world, and it is believed that they saw in that picture the shortcomings.

In the old world we are steeped in tradition, principles and ideals which have been tried, tested and worn for a number of years, with patches here and there to modernize. But, like an old suit—particularly in these days—a time will come when you cannot patch any more, and the article must be discarded. That is exactly what is true to-day in respect of some foundrymen's principles and ideas of labour relations as they meantime exist. They must be discarded and a fresh start made.

The general outlook on life of the American worker is perhaps a great inducement to his greater effort. He is a social climber; he wants to indulge in the good things of life in the same way that his management does and is, by inheritance, discontented.

The British workman today, however, apart from isolated disturbances usually inspired by some foreign element, remains in the main contented with his lot as just a workman and has no aspirations to enjoy all the amenities which, as a Britisher, are his, regardless of rank or social standing.

Profit Sharing

Straightaway, therefore, it is found that the *incentive to earn* is not so strong in this country as it is in America. That is one form of incentive. The other is more practical—profit-sharing and bonus schemes—*the incentive to work*. There is a number of firms in this country practising some kind of incentive scheme, but there are too many that are not. This is regarded as one of the fundamentals towards greater productivity in America, yet it was tried out in this country probably long before the Americans thought about it. To-day, due to the inertia on the part of management to really get down to a scheme and to overcome some of the difficulties involved, and due to a certain amount of opposition from trade unions, the Americans have now gone a long way ahead.

Some weeks ago, Mr. Charles Wilson—the deputy team leader—and the Author, at a week-end conference, were very surprised when one trade union representative, who throughout the conference had made many most helpful suggestions, rose up on his feet and said that he was opposed to profit-sharing schemes because in the past management had not played the game and had reduced the rate when it was found that a workman was earning too much money. Why on earth he could not let the skeleton rest peacefully in its cupboard was difficult to understand. If we are to try to stand still on the happenings of the past we shall

just slide backwards. His complaint reminded the Author of a visit paid to a firm in the States. The finest car on the works car-park there was owned by a moulder. Did the managing director care about that? Not he! He knew jolly well that if the moulder was making enough money to pay for that car he was making good money for the firm.

Esprit de Corps

Finally, there is a subject more intangible than the others and, therefore, the more difficult to put over—the general atmosphere between management and worker in the United States. Disraeli once said "We put too much faith in systems and look too little to men." There is undoubtedly a greater bond of friendship, a greater union, a real team spirit in the United States. Whilst both sides look after themselves, there is a co-operation which brings about its own reward to those who are prepared to work. Both management and labour realize that they are dependent upon one another. Both respect one another's abilities, be it brain or brawn. Trade unions, in the interests of their members, work in as close harmony as possible with management. Nothing pleases them more than to see firms making high profits; they know too well that high profits and high wages walk arm in arm.

Management and unions in this country could do so much more to-day if they would only get closer together. The workman has to serve two masters—his employer and his union; to serve two masters at any time is difficult enough, but if they are both pulling in opposite directions it is well nigh impossible. The wide ravine between management and labour, almost to the extent of being two entirely different people, can be bridged, and it is purely a question of leadership.

"Why Works Information?"

In connection with his paper, Mr. Dewsbury showed a film entitled "Why Works Information?" It depicted the delivery to a factory of a machine which was reputed to be capable of doing the work of five men. As the news filtered around the factory the men feared that some of them would become redundant. As a result, production dropped, and this in turn led to discussions between workers' representatives and management. As the outcome of the steps taken, production increased much beyond the former level; and it was further decided to form a full-scale works council to discuss such matters at regular intervals.

Dust in Foundry Dressing Operations

By W. B. Lawrie

Continuing the proceedings, MR. W. B. LAWRIE, M.Sc., F.R.M.S., A.I.M. (H.M. Inspector of Factories, Engineering and Chemical Branch), presented a Paper on dust in foundry dressing operations. After dealing briefly with the work instituted on this subject by the Joint Standing Committees on Conditions in Iron and Steel Foundries and the assistance offered by official foundry organizations as well as private firms, Mr. Lawrie reviewed the objectives and spheres of operation in non-ferrous foundries for dust and fume control.

The development work in general was directed to the improvement of the foundry atmosphere, and it was believed that the first and best method of improving that atmosphere was to alter a process in such a fashion that a smaller amount of dust or fume was produced. This method should be progressively applied until in the ideal case there would be no necessity for dust control because there would be no dust. For example, a large amount of dusty dressing was necessitated in a steelfoundry dressing-shop simply because sand burnt on to the casting. The British Steel Founders' Research Association had fundamental scientific work in hand at the universities of Sheffield and Cambridge in an attempt to elucidate the chemical and physical reactions which took place at the metal/sand interface. With this work brought to a successful conclusion, founders should be in a much better position to prevent sand from burning on.

Non-ferrous Applications

There were many instances in non-ferrous foundries in which this kind of fundamental research work might easily produce very valuable results. Attention might be given to such things as the use of chlorine for de-gassing in certain aluminium foundries, the use of borofluorides and sulphur during magnesium casting, the use of silicafluorides, the use of mould-dressing materials suspended in carbon tetrachloride or other chlorinated hydrocarbons; and the use of hexachlorethane. The best way of controlling dust and fumes was probably also the most difficult one, which might well involve long-term research projects, and demand great skill coupled with great mental flexibility in those who were operating the process.

The second general method for use in non-ferrous foundries has been directed to the elimination of the dangerous fraction of the total dust or fume concentration. An example was the great efforts being made to avoid the use of silica-flour in steel moulding, and this again has involved a very wide range of fundamental technical and practical problems. Finally, founders were also using many of the more usual methods of dust control, including the use of water, the use of local exhaust ventilation, and the use of personal protection in the form of respirators. The British Steel Founders' Research Association had developed a new mask during the last two years, and this was the most efficient, and probably also the most comfortable mask, now available. It was considered, however, that personal protection should rank no higher than a first-aid measure until better methods were evolved. A good deal of work has also been put into the use of water and wet water. Although results to date had been somewhat indeterminate, there was no doubt that in a mechanized moulding shop the whole of the dust could be controlled after the knock-out if anyone could devise

Incentives, Labour Relations and Good Housekeeping

a method of wetting the sand as fast as it fell through the grid. By wetting was meant diffusing the water in the same fashion that the sand-mill did before the sand was used for moulding. This apparently simple solution to the problem was, however, bristling with difficulties. Additionally, there was the method of dust control by local exhaust ventilation, and members would see recent developments on this aspect of the work in the film which was to be shown.

Film on Dust Collection

Following the Paper, a film was shown dealing with the observation of dust in foundry dressing operations. In his commentary on the film, Mr. Lawrie pointed out that the dangerous dust in the steelfoundry dressing shop was of less than 10μ in size, and most of it was of less than 5μ; in the steel dressing shop 80 per cent. of the dust was less than 1μ—and there are 1,000μ to a mm. The film showed that with the pneumatic chisel as used in dressing shops the heavy particles of dust moved in the anticipated direction. The finer size ranges of dust, however, hung on to the chisel point, moved away from the chisel by not more than 6 in., then turned back and flowed up the chisel and along the arm of the operator, rising to his face. In the case of the portable abrasive wheel the dust turned back over the wheel and circulated in a vortex above and behind the centre point of the wheel. Those results, he said, had not yet been fully explained. The film next depicted a new type of dressing-bench, in which was incorporated a jet of air to turn the dust into the exhaust vent. Mr. Lawrie said it had given the best results so far obtained. Using 600 cub. ft. of air per min. instead of the normal 1,000 cub. ft. per min., more than 80 per cent. efficiency had been achieved in dust collection (by count, not by weight). It was probably the most efficient application of local exhaust ventilation yet seen.

Conclusion

Very great changes were being made in the ferrous industry, perhaps the most noteworthy feature being the fashion in which the various Committees headed by the Joint Standing Committees set up by H.M. Chief Inspector of Factories had co-ordinated their efforts to meet the versatility and complexity of the industry. Better conditions were being sought through the medium of superior foundry methods and in a fuller understanding of the art of moulding. It was not believed that foundry processes or foundry materials necessarily implied unpleasant conditions. The Author would be well satisfied if he had helped to set a limit to the domination of physical limitations and if he had spurred some non-ferrous foundryman to join other research workers as they tried to mould the industry round a more generous conception.

Wasters due to Crushing

By "Coroner"

A base-casting for a machine-tool was giving considerable trouble from dirt inclusions due to the crushing of a core-print by a core. Fig. 1 is a sketch of the casting and A indicates where the defective parts were often located. The pattern equipment had been supplied by the customer and was used as sent until repeated trouble forced the foundry to make modifications in it. The pattern carried a print on the bottom as at B, Fig. 2, and the core-box supplied had the main core attached to this print. The trouble occurred on assembly, for as the core was lowered in position it was impossible for the moulder to see the print B, and invariably there would be a "crush." Removing the core and cleaning out the dirt did not help matters as often, when the core was replaced, a further "crush" took place.

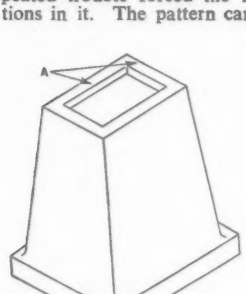


FIG. 1.—*Base Casting for a Machine-tool where trouble was experienced at A, due to crushing.*

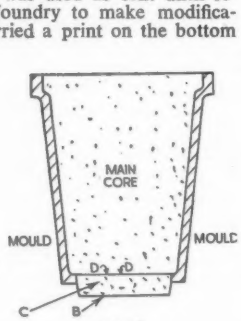


FIG. 2.—*Revised Method for Making the Base Casting, with an Additional Core at C.*

After a number of castings had been made by this method it was found that if good castings were to be made it would be necessary to make the core in two parts. For this, part C (made in a separate core-box and abutting to the line DD in the original box) was placed in the mould first, an operation which could well be seen, and then the main core was lowered on to this, the positioning being accomplished by the use of thickness strips. The lower part of the original core-box was filled-in to allow of the production of the modified core.

This is a case of trouble experienced from the patternmaker's lack of appreciation of the moulder's difficulties and working from the mistaken idea that the core-print must invariably be attached to the main core.

OVER 3,000 manufacturers of combustion appliances, distributors of fuel, and fuel users in the north are being invited to join a northern section of the Combustion Engineering Association which is to be inaugurated at Leeds on September 24.

Experiences with the Investment Casting Process*

Discussion of Mr. D. F. B. Tedds' Paper

When Mr. Tedds' Paper was presented to the Birmingham branch of the Institute of British Foundrymen, recent developments in the process as well as manufacturing trends were outlined and some unusual projects described. The discussion, which is reported below, concerned mainly equipment and operational details. Application of vibration to pattern assemblies during investment, special moulding materials and present and future applications were among topics raised. It was clear that members were impressed by the high manufacturing standards revealed as well as the future potentialities of investment procedures.

Vote of Thanks

MR. FRANCIS, who proposed the vote of thanks, said he believed there was an investment material known as Ferrolite, and he would like to know if Mr. Tedds could say how it worked. Regarding the small electric furnace which was used to melt the heat-resisting alloys, he asked if these were constructed at Bristol or whether they purchased them. Could it be confirmed that vacuum methods of casting, and combined vacuum and pressure methods, were sometimes used.

MR. TEDDS said he did not know anything about Ferrolite. The small furnaces were made at Bristol by the firm themselves. Regarding vacuum and combined vacuum and pressure castings, he believed reasonable results were obtained, but they found that castings poured at ordinary pressures were usually quite satisfactory, and they had not felt the modification was worth while.

Furnace-lining Life

MR. TWIGGER said he believed that with the small electric furnace of the indirect-arc type, the lining life was rather short. Could Mr. Tedds explain this? While he appreciated the need for basic linings, he would like to know if the moulds were deliberately cast hot and at what temperature they poured. Could the Author confirm that, for some of the larger castings, the electric furnace had a spherical shape? He also asked whether Mr. Tedds had any experience of centrifugal casting applied to the investment process.

MR. TEDDS replied, regarding lining life, by saying that at Bristol they made a crucible of alumina bonded with ordinary core-compound of a semi-solid type. It was rammed in *in situ* in two halves, dried out at low temperature, and then the two halves were clamped together and the arc was struck, which gradually heated the furnace, burnt out the core-compound and a high enough temperature was reached so that they finished up with about 1-in. lining of pure alumina. The furnace was run 24 hrs. per day for a 5-day week, and a run of as long as five weeks had been achieved; but the general practice was to change linings every week.

As for casting in hot moulds, the ovens were run at about 1,000 deg. C., and the mould temperature was between 850 and 950 deg. C. It was necessary to be fairly smart about getting the mould out and the casting made. The mould took quite a considerable time to drop in temperature. Mr. Twigger was correct in assuming the shape of the furnace to be spherical.

With regard to centrifugal casting, they had tried this, but the point which had been particularly noted was that, at the speed at which they poured, the mould tended to break. They tapped the metal into a crucible, set it in motion, and poured while it was rotating.

MR. TAYLOR asked whether vapour-blast was used for cleaning castings and whether any provision was made for venting at the bottom, for example, the rings shown on a slide.

MR. TEDDS said that they did not use vapour-blast but shot-blasting was employed, which gave a very fine finish. No venting was done; at the temperature at which moulds were cast there was very little air to evacuate. On rare occasions only a small air lock had formed, but this was indeed very unusual.

Coatings and Carbon Pick-up

MR. WOOD asked Mr. Tedds what coating was used for the primary investment.

MR. TEDDS said alumina of a very fine mesh, round about 200, was employed, bonded with sodium silicon, using about 9 oz. for every 100 ml. This was applied by a spray gun at about 30 lb. per sq. in. pressure.

MR. TAYLOR asked whether carbon pick-up would be sufficient to rule out the possibility of casting a case-hardening steel, with a carbon content not exceeding 0.15 per cent. carbon.

MR. TEDDS said that there was a certain amount of carbon pick-up, about 0.01 or 0.02 per cent., but, provided the case-hardening steels were on the bottom limit to start with, they would probably finish at a satisfactory level. It had been found, however, that for no apparent reason, carbon pick-up could shoot up to 1 per cent. even more. This was, fortunately, a very rare occurrence, as they ran for months without this sort of thing.

* Paper printed in the JOURNAL, March 20, 1952.

Investment Casting Process—Discussion

MR. FRANCIS asked why arc furnaces were preferred to induction furnaces.

MR. TEDDS said that (1) they were fairly cheap to produce and (2) operating costs were very low. The advantage of the induction-type furnace was, of course, that there was no carbon pick-up.

Investment

MR. JOHNSTONE referred to the vibration of the mould, and said was it correct to presume that the vibrating was done when the investment was fully added. He could readily appreciate that initially a high percentage of breakages of wax assemblies occurred.

MR. TEDDS said that, in the early days, the mechanical type of vibrator running at between 200 and 250 cycles per minute was used, and every wax assembly was shattered. The rate was then reduced to half. After this, a pneumatic vibrator was secured, which worked at about 2,500 cycles per min., and this certainly cut down breakages. Nowadays an electric vibrator was used and the number of breakages was practically nil. They had tried vibrating while filling the flask, but found it was easier to fill and then start vibrating.

MR. TAYLOR asked whether when using sodium silicate, Mr. Tedds experienced any build-up and whether there were any troubles with slag.

MR. TEDDS said they used sodium silicate in the primary coating, which was not used over and over again. When it was used as a binding agent for the secondary investment, he thought there would probably be a build-up.

Mould Preparation

MR. TAYLOR asked whether cement was used, and, if so, whether there was an iron build-up.

MR. TEDDS said Portland cement which was not reclaimed was employed. The investments were crushed through a mill, and the cement was replaced each time. ANOTHER MEMBER said he had been interested in the material used for the metal tube shown on one of the illustrations. Had Mr. Tedds experienced any scaling in taking this up to 1,000 deg. C. MR. TEDDS replied that hypodermic steel was used for this, and that, although there was a very slight scaling, no trouble developed.

MR. HUMPHRIES asked whether any variation in the packing density was experienced when changing to electric vibration and whether it had a substantial effect on the mould.

MR. TEDDS said there was no difference at all in the quality of the mould, but the saving in packing time was quite considerable.

MR. HUMPHRIES then asked whether difficulty had been experienced when casting high-carbon and low-nickel alloys, for example, 13 per cent. chromium material.

MR. TEDDS said his firm did not favour 13 per cent. chromium steel, but they had not experienced sand fusion, although the surface on the castings was not so good.

MR. HUMPHRIES asked if the Author made up his own alloys; also whether burning-out of alloys from the bar stock was experienced.

MR. TEDDS replied that as a general rule they bought the material to specification, but there had been one or two cases where they had made up their own material and found a slight loss in chromium, but well within specification. The only other point was that they tended to lose titanium during melting.

Alternative Metals and Investments

MR. HUNTER said he believed that in the United States they were now making use of virgin titanium metal for certain aircraft parts, and he wondered whether Mr. Tedds had any experience of the investment casting of titanium.

MR. TEDDS replied that they had tried cobalt, but not pure titanium.

MR. TWIGGER referred to carbon pick-up from the electrodes in the arc furnace and said his firm had experienced some trouble in this manner, although it had usually been associated with damp electrodes.

MR. FRANCIS asked whether any difficulty was experienced with contamination from furnace linings when changing over from one metal to another.

MR. TEDDS pointed out that to obviate this possibility a wash-out melt was interposed. A MEMBER understood that in America there was a system whereby mercury was used instead of wax as a pattern material, and that this was stated to be a very good method of production.

MR. TEDDS said his firm had tried making frozen mercury patterns, but the difficulty was in controlling the primary coating and then the investment. It was claimed that a very accurate pack was obtained from this method, but there was much hazard in controlling the process.

Wax Jointing

MR. HUMPHRIES asked if Mr. Tedds would enlarge on methods of wax welding.

MR. TEDDS said that where they had to join one pattern to another a mark was left at the joint. They had tried plastic types of material for jointing which had been partially successful on some jobs, but a hand finishing operation had to be carried out. The method used was to employ either small electric knives, or a spatula heated in a Bunsen burner. This was warmed and touched on the part to be welded and the joint was subsequently hand finished.

MR. HUMPHRIES asked additionally what happened when the joint was on the inside.

MR. TEDDS agreed that the inside was inaccessible for jointing, but they made certain that there was not a crack underneath the particular job under discussion. Excess wax was allowed underneath, which could be taken off afterwards.

MR. TWIGGER asked was any wax recovered.

MR. TEDDS said about 65 per cent. was recovered.

Conference on Foundry Economies

B.C.I.R.A. Function at Ashorne Hill, Oct. 20 to 22

B.C.I.R.A. FUNCTION at Ashorne Hill, Oct. 20 to 22

A conference, organized by the British Cast Iron Research Association, will be held from Monday afternoon, October 20, to Wednesday afternoon, October 22, at Ashorne Hill, near Leamington Spa.

The provisional programme includes the following:—"Pig-iron Supplies"—the makers' point of view by Dr. J. E. Hurst and the users' point of view by Mr. P. A. Russell; "Conservation and Correct Use of Low-phosphorus Iron" by Mr. J. J. Sheehan; "Coke Supplies and Quality" by Mr. J. W. Grant; "Economical Use of Moulding Sands" by W. B. Parkes; "Fuel Economy and Melting Practice" by Mr. J. D. Hullock; "Carbon Pick-up" by Dr. H. T. Angus; "Need to Conserve Alloy Additions" by Dr. J. G. Pearce; "Rational Foundry Management" by Mr. F. Buckley; "Psychological Aspects of Management" by Dr. A. A. White; "Work Simplification" by Mr. W. Rodgers; "Magnetic Recovery of Scrap Metal from Moulding Sands" by Mr. T. G. Hawker; "Utilization of Swarf in the Cupola" by Mr. W. H. Bamford; "Melting of Cast-iron Borings by the Croft Process" by Mr. D. W. Hammond and "How the British Cast Iron Research Association can help with Advice" by Dr. J. G. Pearce.

Readers desiring an invitation to attend should write to Mr. G. R. Woodward at Bordesley Hall, Alvechurch, Birmingham. The accommodation at Ashorne Hill is limited to 183 persons, and rooms will be allocated in order of application, the closing date for which will be October 8, or earlier if the accommodation is fully taken up. Application forms should, therefore, be completed and returned to the Association as early as possible. It may be necessary to limit the number of individuals attending from any one firm.

Chamberlain & Hill's Extension

Before the foundation stone of a new foundry was laid on the site of an old brewery at Lichfield last Friday afternoon, Mr. G. A. L. Hatton, the chairman of the company concerned—Chamberlain & Hill, Limited, of Walsall and Lichfield—disclosed that the firm hoped to raise the whole capital cost out of reserves without recourse to borrowing or the issue of fresh capital. The amount involved in the new foundry at Beacon Street, Lichfield, is believed to be in the neighbourhood of £100,000—expenditure possible because the directors have ploughed back into the business a large proportion of the profits since the company started in the 1890's.

The foundation stone was laid by Mrs. H. F. Bather, a director, and guests included work-people and their families from Walsall and Lichfield, the Mayor and Mayoress of Lichfield (Councillor and Mrs. C. W. Bridgeman), the Sheriff of Lichfield and Mrs. T. F. Winterton, Mr. Julian Snow, M.P. for Lichfield, and Mr. Stanley N. Evans, M.P. for Wednesbury.

The new foundry, due to be in full production in the Spring of 1953, is being built on a site at the rear of the firm's existing Phoenix foundry. When the old buildings are removed, the frontage to Beacon Street will be laid out with lawns and may eventually be the site of cottages for employees. Equipment for the new foundry, with partial mechanization, will include an automatic sand-handling and preparation plant, and will make it one of the most modern in the West Midlands. Special attention is being paid to welfare facilities, such as shower-baths and canteens.

Worshipful Company of Founders

Robert Warner Fellowship

Under the terms of the will of the late Robert Warner, a former Master of the Worshipful Company of Founders, the Company is charged with the administration of a fund for the purpose of creating Fellowships to foster research applied to foundry practice. The Company invites applications from interested candidates with a view to an award being made by March, 1953, to commence in October, 1953. Applications should be sent to the Clerk to the Company, Founders' Hall, 13, St. Swithin's Lane, London, E.C.4, by the end of the year 1952.

In interpreting the bequest, the Company has wide and absolute discretion and for this first award it does not desire to stipulate the age, previous training or qualifications of candidates, or where the research should be conducted. Indeed, the work need not necessarily be regarded as a full-time occupation and may cover the whole field of appropriate research and its application, provided it has specific relation to foundry practice. Candidates, however, must be natural-born British subjects of British parents. In view of this, the Company consider it undesirable to indicate the funds which would be available, but in no circumstances is it likely that the amount available for a period equivalent to a year would exceed £600.

The Company also has a scheme for the award of Fellowships which are primarily intended to give facilities for advanced education to men who have already completed their normal course of training. The Company believes that these two types of award serve different purposes and consequently in no circumstances can the two awards be held at the same time, although the possibility of one candidate holding both awards at different times is not excluded.

The Company will require to be satisfied that the proposed subject for research is likely to prove sufficiently valuable to the industry; that the facilities available to the individual are adequate; that the character of the applicant is satisfactory; that the capacity and ability of the applicant are adequate to deal with the work proposed; and that sufficient supervision of its progress can be provided. It is a condition of the award that periodical reports of progress shall be furnished to the Master of the Company, and that the successful candidate shall be prepared to report this progress personally during his period if required by the Company so to do; that any equipment which may be bought for the holder of a Fellowship shall remain the property of the Company; and that after completion of the period a full report shall be prepared, the copyright of which will vest in the Company, which shall, without payment to the Fellow, have power to make the results obtained available to the foundry industry as it may deem advisable.

COUN. A. G. B. OWEN told the Midland Federation of Trade Councils at its quarterly meeting on September 13 that his firm, Rubery Owen & Company, started as a family business and had been carried on in that tradition by himself and his brother. The firm had never paid dividends, having no shareholders, but had ploughed back for the good of the employees, all that was gained apart from earned remuneration. Coun. Owen, who is president of the Wednesbury, Darlaston and District Manufacturers' Association, said that he thought the Association's industrial relations sub-committee was doing much good in fostering closer understanding between management and operators.

Changes of Name

The undermentioned companies have recently changed their names. The new titles are shown in parentheses.

GUNTEX, LIMITED, engineers, etc., of Brentford (Middx) (Gunac, Limited).

INGOT METAL COMPANY, LIMITED, London, W.C.1 (Ingot Metal Investments, Limited).

BROMBOROUGH STEEL COMPANY, LIMITED (Bromborough Investment Company, Limited).

ADVANCED STEEL STRUCTURES, LIMITED, London, S.W.11 (Young, Dunning & Company, Limited).

BRINELL MACHINE TOOL COMPANY, LIMITED, London, S.W.16 (Brinell Machine Tools, Limited).

WM. WATERS (NEATH), LIMITED, scrap metal merchants, of Swansea (Glyntaff (Metals), Limited).

PERCY GUMMER & SONS, LIMITED, Sowerby Bridge (Yorks) (Ryburn Engineering Company, Limited).

BENNETT & TONKIN, LIMITED, mechanical engineers, etc., of London, W.1 (Timken-Fischer Stockists, Limited).

H. H. COOPER & COMPANY (VERWOOD), LIMITED, engineers, etc., of Wimborne (Dorset) (Gull Enterprises, Limited).

OIL-OPERATED PATENTS, LIMITED, engineering consultants, etc., of London, S.W.1 (T. Hindmarch & Company, Limited).

BRITISH CONTINENTAL SYNDICATE, LIMITED, London, N.2 (British-Continental Machine Tool Syndicate, Limited).

PANTA INDUSTRIAL SUPPLIES, LIMITED, machinery and metal merchants, etc., of London, W.1 (Panta (Instruments), Limited).

INSTITUTE OF METAL FINISHING INCORPORATING ELECTRODEPOSITORS' TECHNICAL SOCIETY, LIMITED, London, W.C.1 (Institute of Metal Finishing Incorporating Electrodepositors' Technical Society).

Advertising the B.I.F.

A worldwide promotion campaign is to be launched this month to attract buyers to the 1953 British Industries Fair, which will be held in London and Birmingham from April 27 to May 8. A start will be made in initial Press advertising in Australia and New Zealand, in the issue of the first batch of letters in the overseas direct mail campaign, which will go to buyers in Eastern countries and in South America, and in approaches to exhibitors for information to be used in the fair's service of product news to buyers. Special advertising plans are in preparation for the United States and Canada, where the services of local agents with experience of marketing in the dollar area will again be utilized. There will be individual advertising in the Press of the Commonwealth and of Europe. Altogether, more than 130,000 known buyers in 60 countries will receive letters bearing invitations and news of the fair.

British Association's 1953 President

At a council meeting in Belfast of the British Association for the Advancement of Science—where the 114th annual assembly of the association was opened recently—Sir Edward Appleton, F.R.S., was chosen to succeed Prof. A. V. Hill, F.R.S., as president of the association for 1953. In that year the annual meeting will be held in Liverpool.

Sir Edward, who is principal and vice-chancellor of Edinburgh University, had his 60th birthday this month. He was secretary of the Department of Scientific and Industrial Research from 1939 to 1949, and was awarded the Nobel Prize for Physics in 1947.

JOWETT CARS, LIMITED, of Idle, Bradford, have announced that arrangements have been made for their cars to be assembled in Australia. The headquarters of the company, to be known as Jowett Cars (Australia) Proprietary, Limited, will be in Melbourne, with Mr. Ted Gascoyne as general manager.

Increases of Capital

The following companies are among those which have recently announced details of capital increases:—

HOMA FOUNDRY, LIMITED, Birmingham, increased by £5,000, in £1 ordinary shares, beyond the registered capital of £500.

POWER DIESELS, LIMITED, Weybridge (Surrey), increased by £2,500, in £1 ordinary shares, beyond the registered capital of £2,500.

D.S.T. PATTERN MAKING COMPANY, LIMITED, Bury, (Lancs), increased by £1,000, in £1 shares, beyond the registered capital of £1,000.

DEUTSCH & BRENNER, LIMITED, metal merchants, of Birmingham, increased by £50,000. in £1 shares, beyond the registered capital of £70,000.

LICHFIELD FOUNDRY, LIMITED, Lichfield (Staffs), increased by £6,000. in £1 ordinary shares, beyond the registered capital of £4.000.

G. & J. WEIR, LIMITED, engineers, etc., of Glasgow, increased by £1,427,231, in 5s. ordinary shares, beyond the registered capital of £672,769.

F. PRATT & COMPANY, LIMITED, machine tool makers, etc., of Halifax, increased by £90,000, in £1 unclassified shares, beyond the registered capital of £110,000.

HARRY FERGUSON, LIMITED, manufacturers of tractors, etc., of Coventry, increased by £500,000, in £1 ordinary shares, beyond the registered capital of £500,000.

FRY'S (LONDON), LIMITED, mechanical and electrical engineers, of London, S.E.1, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £20,000.

ASEA ELECTRIC, LIMITED, manufacturers of electrical machinery, etc., of London, E.17, increased by £50.000, in £1 ordinary shares, beyond the registered capital of £600,000.

JOHN THOMPSON, LIMITED, manufacturers of boilers, superheaters, etc., of Wolverhampton, increased by £150.000, in 5s. ordinary shares, beyond the registered capital of £1,250,000.

ANEMOSTAT (SCOTLAND), LIMITED, manufacturers of ventilating plant, etc., of Glasgow, increased by £15,000, in 10s. ordinary shares, beyond the registered capital of £10,000.

MATTHEW HALL & COMPANY, LIMITED, hydraulic and heating engineers, of London, N.W.1, increased by £150,000, in 5s. ordinary shares, beyond the registered capital of £100,000.

FRANK GUYLEE & SON, LIMITED, engineers, of Sheffield, increased by £97,500, in 2,500 preference and 95,000 ordinary shares of £1 each, beyond the registered capital of £52.500.

GOODWIN BARSBY & COMPANY, LIMITED, iron-founders, etc., of Leicester, increased by £50.000, in £1 6 per cent. redeemable preference shares, beyond the registered capital of £55,000.

CANNON (HOLDINGS), LIMITED (formerly Cannon Iron Foundries, Limited), Deepfields, near Bilston (Staffs), increased by £1,000,000, in 10s. ordinary shares, beyond the registered capital of £500,000.

BUCK & HICKMAN, LIMITED, iron and steel stockholders, of London, E.1, increased by £360,000, in 120,000 preference, 120,000 ordinary and 120,000 unclassified shares of £1 each, beyond the registered capital of £640,000.

PNEULEC, LIMITED, engineers, of Smethwick (Staffs), increased by £25,000, in 10s. shares, beyond the registered capital of £100,000. At May 20, 1952, Birmid Industries, Limited, held a majority of the issued shares.

DARTMOUTH AUTO CASTINGS, LIMITED, Smethwick (Staffs), increased by £50,000, in £1 shares, beyond the registered capital of £175,000. At January 2, 1952, Birmid Industries, Limited, held practically all the issued shares.

FORDATH ENGINEERING COMPANY, LIMITED, West Bromwich, increased by £50,000, in 10,010 "A" ordinary, 16,610 "B" ordinary, 23,360 "C" ordinary and 20 unclassified ordinary shares of £1 each, beyond the registered capital of £17,000.

GILBERT & KELLETT, LIMITED, engineers of Barrow-in-Furness, increased by £10,000, in £1 "B" ordinary shares, beyond the registered capital of £10,000. On May 1, 1952, British Laundry Machinery Company, Limited, was allotted 10,000 "B" ordinary shares.

FRANCIS SHAW & COMPANY, LIMITED, hydraulic machinery manufacturers, of Manchester, increased by £33,409, in 32,000 6½ per cent. cumulative redeemable preference, 1,064 ordinary, and 345 employees' shares of £1 each, beyond the registered capital of £156,591.

STERLING METALS, LIMITED, Coventry, increased by £50,000, in £1 ordinary shares, beyond the registered capital of £300,000. On December 24, 1951, Birmid Industries, Limited, held 299,995 shares out of 300,000 issued. This company was allotted a further 25,000 shares on July 2, 1952.

NEW MENDIP ENGINEERING COMPANY, LIMITED, manufacturing engineers, of Atworth, near Melksham (Wilts), increased by £50,000, in £1 shares, beyond the registered capital of £10,000. At December 20, 1951, Dowty Equipment, Limited, Cheltenham, held 6,499 shares out of 6,500 issued.

News in Brief

BUILDING commenced this week on an extension to the laboratory at Foundry Services, Limited, Nechells, Birmingham.

THE FINAL REPORT on the Census of Production for scrap metal (volume 3, trade H) for 1948 was on sale from September 9 at H.M. Stationery Office, price 2s. (2s. 1½d. post free).

KIDDERMINSTER has set a target of two tons of scrap metal per 1,000 of the population for the scrap-metal drive organized in the town for the week beginning September 15, and hopes to beat the record at present held by Kettering.

A 10,900-TON CARGO SHIP has been ordered by the United British Steamship Company, Limited, London, from Bartram & Sons, Limited, Sunderland. The engines will be built by John G. Kincaid & Company, Limited, Greenock.

A TWO-YEAR COURSE on the United States designed to portray the economic background of America for the guidance of industrialists interested in the export trade, has been arranged to begin in January, by the extra-mural department of Birmingham University.

LIMBRICK WOOD PRIMARY SCHOOL, the fourth school in Coventry to be built largely of aluminium, opened with the present school term. Built by the Bristol Aeroplane Company (Western), it is the first to be designed by the Ministry of Education in conjunction with the Coventry Education Authority.

GRANTHAM IRONWORKS COMPANY, LIMITED, Springfield Road, Grantham, have received approval from the Ministry of Supply for an extension to the existing foundry premises, which will incorporate a modern and up-to-date fettling-shop and despatch department. A new mess-room will also be included in the scheme before completion.

COUN. E. H. FRYER, deputy Mayor of Leamington, welcomed members of the Incorporated Sales Managers' Association when they met for a conference in Leamington on September 6. Mr. V. W. Olver presided, and among the principal speakers was Mr. R. H. Penney, national chairman of the I.S.M.A.

A NEW FACTORY and foundry covering about 14,000 sq. ft. is to be built on the Westwood industrial site at Margate by the Emco Brass Manufacturing Company, Limited, at present at Croydon. In a statement, Mr. W. S. Judd, managing director, said that work was expected to begin in the near future. A long-term plan provides for an extension to 40,000 sq. ft.

STIRLING WAR COMMEMORATION FUND COMMITTEE have accepted the offer of John Taylor & Company, Loughborough, to supply a chime of eight bells (largest bell 19 cwts.), at a cost of £2,400. It is hoped to have the bells installed in the tower of the Municipal Buildings in time for the Coronation next year.

AN ORDER has been placed with F. Perkins, Limited, Peterborough, by the Canadian Government, for 1,355 Diesel engines. The value of the order is about 1,250,000 Canadian dollars. The engines, delivery of which is expected to begin this year, will be fitted into Canadian-built vehicles, and, as such, represent part of the Colombo Plan.

Negotiations are in progress between Great Britain and Voest, the Austrian iron and steel works company at Linz, for a further shipment of pig-iron to the U.K. Earlier this year a deal was concluded involving delivery of 80,000 tons of steel and pig-iron to Great Britain, against delivery of British coal to Germany and delivery of Ruhr coal to Linz.

TWO TRAINS from Smethwick and two from Birmingham as well as others from Newtown (Montgomeryshire) will depart for Blackpool on September 27 carrying 3,500 employees of J. A. Phillips & Company, the cycle manufacturers, for their annual outing. Elaborate arrangements have been made to make the venture successful, including the provision of special cafeteria coaches on the trains.

THE INSTITUTE OF WELDING deserves the thanks of the Press as well as its members for issuing their programme for the forthcoming session in the form of a sheet of gummed labels, perforated and rouletted for easy separation. If other technical societies would only emulate this meritorious practice, much time would be saved in making diary entries and a potential source of error would be eliminated.

THE CONTRACT for the construction of two new building berths, capable of handling ships of more than 30,000 tons d.w., at the Wallsend (Northumberland) yard of Swan, Hunter & Wigham Richardson, Limited, has been let to Holland & Hannen & Cubitts, Limited. The piling work will be done by Holmpress Piles, Limited, Hull. It is also proposed to build a crane gantry and a jetty extension 135 ft. long.

A SPECIAL PANEL to consider the White Paper on the iron and steel industry has been appointed by the Tees-side and South West Durham Chamber of Commerce. Advocating this course, Mr. C. Robson, chairman of the home affairs committee, said that some industrialists believed that the proposed Iron and Steel Board would not only control iron and steel production but also the production of iron and steel castings.

RECENTLY, the plant of the Renishaw Iron Company, Limited, was open for inspection by members of the public who saw the blast-furnaces in operation, watched the tapping of pig-iron and inspected the foundries, power-plant, the new baths and showers and ambulance rooms. The visitors were also entertained to light refreshments in the works' canteen. Every employee received a personal invitation from the directors to bring his family and friends and over four hundred visitors, including members of the local Parish and County Councils, were received.

B. R. HOMERSHAM, LIMITED, 25, Bealey Street, Christchurch, wishes to obtain the New Zealand representation of U.K. manufacturers producing flow metering equipment for steam and gas at low and high pressure, and waterworks valves and pipes for gas and water mains. Interested firms should communicate with Mr. B. R. Homersham, whose address for the next three months will be c/o H. Perkins, Esq., 1, Beresford Road, Harrow (Middx), at the same time notifying the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (reference, CRE/28493/52), of any action taken.

AN OUTBREAK OF FIRE at the premises of William Whiteley & Sons, Limited (incorporating J. Charlesworth), textile engineers, Prospect Iron Works, Lockwood, Huddersfield, on September 2, gutted one of the pattern-stores, destroying several hundred patterns, one stated to be particularly valuable. The alarm was raised by a foreman at David Brown & Sons (Huddersfield), Limited, Park Works, and employees from the adjoining Keighley Gear Company gave assistance to members of Huddersfield Fire Brigade in running out their hoses. The firemen were able to confine the blaze to the store, the roof of which collapsed. It is not expected that the fire will result in any interference in production.

Personal

MR. JOHN P. MCFARLANE, proprietor of McFarlane & Company, iron and steel stockholders, of West Grimsby, Arbroath (Angus), has retired on selling his business.

MR. ROBERT B. CHARLTON, who founded R. Blackett Charlton & Company, Limited, non-ferrous founders, of Newcastle-upon-Tyne, has celebrated his 101st birthday.

MR. F. GOLDSMITH has joined Foundry Services, Limited, as resident technical representative in India and Pakistan. Mr. Goldsmith was previously with Morgan Crucible Company, Limited, of Battersea, London.

THE MINISTRY OF MATERIALS has announced that MR. PHILIP G. SMITH, a director of Bassett Smith & Company, Limited, will be appointed Government broker from October 1 for all sales of lead on the London Metal Exchange from Ministry stocks.

MR. GEORGE M. DUNBAR, commercial manager at John Fowler & Company (Leeds), Limited, engineers, Hunslet, Leeds, has been appointed to the Board of directors. Before joining the firm in 1950, he was commercial manager at Vickers-Armstrong, Limited, Barrow-in-Furness.

MR. HENRY NIMMO, M.I.C.E., M.I.Mech.E., M.I.E.E., has been elected president of the Engineers' Guild in succession to Mr. Robert Chalmers, O.B.E., B.Sc., M.I.C.E., M.I.Mech.E., whose term of office expires on September 30. Mr. Nimmo is chairman of the Southern Electricity Board and a part-time member of the British Electricity Authority.

MR. ALAN B. CAMERON, draughtsman, from Motherwell, who took an appointment in Southern Rhodesia last October, has been appointed chief draughtsman with the Rhodesia Iron & Steel Company at Riscom, a new town. He served his apprenticeship with Colvilles, Limited, and before going to Southern Rhodesia, he was with Lamberton & Company, Limited, of Coatbridge.

MR. T. H. SUMMERSON, chairman of the British Steel Founders' Association, will be joining Mr. C. Hughes, past-chairman of the Electric Lamp Manufacturers' Association, in the controversial discussion on the "Effect of Price Rings upon Industry" which is taking place at the 21st anniversary conference of the Purchasing Officers Association, being held at Harrogate, October 2 to 5.

COLONEL ARTHUR JERRETT, a director of Guy Motors, Limited, and president of the Traders' Road Transport Association, is to represent British commercial vehicle operators at the International Road Transport Union in Madrid later this month. Col. Jerrett is visiting Spain and Portugal primarily on business for his company, but while in Madrid he will take the opportunity to visit the International Union meetings.

MR. JOHNSTON F. ROBB, B.Sc., has been awarded a scholarship by the American Mutual Security Agency and is now on his way to the Massachusetts Institute of Technology in Boston. He is employed by Scotts' Shipbuilding & Engineering Company, Limited, Greenock, and has been granted leave of absence by the firm for a year. While in America, he will study American management and production techniques. The scholarship competition was open to honours graduates from all British universities, and is valued at £1,400. MR. GEORGE FORRESTER an engineering graduate of Glasgow University, has also left for America. He has won a scholarship sponsored by Atlanta, Ga, Rotary Club. He was employed as an engineer at Singer's of Clydebank, and in New York he will visit the Singer factory.

Obituary

MR. W. E. DOBSON

The death occurred recently of Mr. W. E. Dobson, managing director of British Pigirons, Limited. Mr. Dobson had been in the pig-iron business all his commercial life. Before he joined Wm. Jacks & Company, Limited, in about 1924, he was on the staff of Kittel & Company. When Major Tavenor died in 1937, Mr. Dobson joined British Pigirons, Limited. His activities involved much foreign travel for which he was well suited, as he was an accomplished linguist. He always took a profound interest in foundry technology and was one of the oldest members of the Institute of British Foundrymen, having joined the London branch in 1914. During his long career he exercised his innate gift for making friends amongst ironmasters and foundrymen and his cheerful and exuberant personality will long be missed.

FORMERLY a director of Barnet & Morton, Limited, iron and steel stockholders, of Kirkcaldy (Fife), MR. ROBERT BRAID MARTIN died on September 4.

ENGINEER COMMANDER ALBERT JOHN CARNT, formerly a director of Peter Brotherhood, Limited, engineers, of New England, Peterborough, has died at the age of 87.

MR. ISAAC HORACE SHAW, a director of Isaac Shaw Metals, Limited, died on September 8 at the age of 49. He joined the firm on leaving school and was appointed a director during the war.

THE AMERICAN PRESS reports the death of Mr. Arnold W. Lenz, a vice-president of General Motors Corporation. Both he and his wife were killed in a motor-car accident. Mr. Lenz started his career as a moulder and worked his way through all steps of management to be the only foundryman to be appointed a vice-president of General Motors. He was a recipient of the Whiting Medal award of the American Foundrymen's Society.

Dorman, Long's Coke-oven Project

Outline plans submitted to the Eston Urban District Council reveal the intention of Dorman, Long & Company, Limited, to erect a new coke-oven plant, consisting of 150 to 170 ovens, at its Cleveland works, and to establish a stockyard capable of accommodating 60,000 tons of coal. At a later date it is the intention of the company further to expand the coking plant and to extend the capacity of the coal stockyard by a further 50,000 tons. By-product plant extensions are planned to keep pace with the increased coke-oven capacity.

These plans have not yet received the approval of the local authority and further discussions between the two parties are to take place in the near future.

INCLUDED on the stand of the Carborundum Company, Limited, at the International Machine Tool Exhibition (Olympia, London, September 17 to October 4) is a range of Carboflex cutting-off wheels. Performance figures will be available for various typical grinding-wheel set-ups.

ONE OF THE LATEST productions emanating from the research department of William Jessop & Sons, Limited, is an austenitic nickel-base casting alloy, G.39, intended for use in the "as-cast" condition. It has a comparatively low coefficient of thermal expansion and it is particularly suitable for precision-cast nozzle guide vanes.

ARON FOUNDRY EQUIPMENT

We specialise in the manufacturing of,

SINGLE HAND SHANKS.
From 28 lbs. Capacity.

DOUBLE HAND SHANKS.
From ¼ to 3 Cwts.

GEARED CRANE LADLES.
Completely Enclosed Machined Gears with or without Covers. 3 Cwts. to 2 Tons.

UNGEARED LADLES.
With Ball or Detachable Handles. From 3 Cwts. to 30 Cwts.

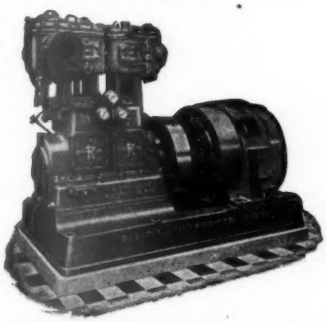
Price Lists on application to:

H. BECK & SON LTD.,
MARLEY ST., KEIGHLEY,
YORKS.

Phone 4132.

COMPRESSORS & EXHAUSTERS

FOR AIR OR GASES



These Vertical double-acting crosshead type compressors are built as single and two-stage machines for pressures up to 40 and 120 lbs. per sq. in. They are built in a range of sizes for capacities up to 10,000 and 5,000 cu. ft. per minute respectively

For particulars of these machines and for other types write to s Ref. Y

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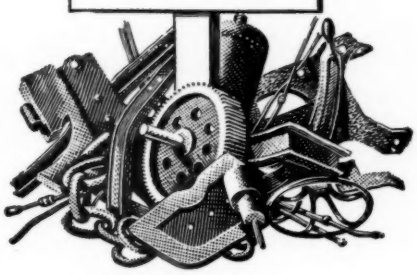
WHAT EVERY MANAGEMENT SHOULD KNOW ABOUT

scrap



What is scrap? Obsolete plant and machines, old spares, redundant buildings — anything made from iron and steel for which you have no foreseeable use.

What good is it to me? No good at all in its present state. But send it back to the steelworks and it can go to make the new steel that you and all steel-users need. Remember — a ton of scrap may make a ton of new steel.

Can't they make steel without scrap? Yes—but not enough steel. Last year, 58% of our steel was made from scrap. The more scrap we use the more coal, coke and iron ore we save for other important purposes.

What should I do with my scrap? See your local scrap merchant. He will be glad to help with dismantling and collection. If you have any trouble disposing of iron and steel scrap, write to the British Iron & Steel Federation for the address of your Joint District Scrap Committee.

What shall I get for it? You will be paid a fair price for your scrap. MORE IMPORTANT — you will be doing yourself and all steel-using firms a great service by helping to increase steel production.

SPEED THE SCRAP

SPEED THE STEEL

Issued for the STEEL SCRAP DRIVE, by the British Iron and Steel Federation and the National Federation of Scrap Iron, Steel and Metal Merchants.

T.28

Raw Material Markets

Iron and Steel

The expansion in steel production is maintained by increased deliveries of raw materials, the larger supply of basic pig-iron being chiefly responsible for the improved outputs. Although scrap imports have shown some improvement, supplies are well below requirements, and the steelworks will continue to depend mainly on the supply of basic pig-iron. By the blowing in of new blast furnaces much has been accomplished in meeting these needs, but more is required to ensure maximum steel output.

While blast-furnace production is concentrated mainly on supplying the steelworks, the output of foundry pig-iron shows little appreciable change. But, with the additional furnaces now producing basic pig-iron, it is hoped that supplies for the foundries will be more assured than in the past. The foundries are taking up all the pig-iron which is offered to them up to licensed quantities. Current allocations have been reduced drastically—up to as much as 50 per cent. in some instances.

Supplies of pig-iron for the engineering and speciality foundries are not too plentiful, and the demand for low- and medium-phosphorus irons and hematite cannot be fully met. The light and jobbing foundries are maintaining fair outputs, but fresh business has slackened, particularly in the case of those catering for the textile trades.

Many foundries are still dependent on current deliveries of pig-iron, and with scrap still scarce, there is little chance of augmenting stocks. Foundry coke is coming to hand regularly, but there is need for more to enable stocks to be brought to a satisfactory level. Ganister, limestone, and firebricks are received to requirements.

The re-rollers have plenty of orders on hand, primarily for home users, as fresh export business is difficult to obtain. Sheet re-rollers have greatly benefited by the importation of sheet bars from oversea. They are very busy and a large proportion of their orders is for export as prices compare favourably with oversea makers. All arisings of defectives and crops find a ready market.

Non-ferrous Metals

The figures relating to stocks and consumption, issued by the British Bureau of Non-ferrous Metal Statistics, show that copper consumption in July dropped from the June total of 46,591 tons to 45,113 tons, virgin copper used being nearly 2,500 tons lower, while scrap showed an increase. Stocks of copper increased somewhat from 106,809 tons at July 1 to 107,619 tons at the end of the month. In zinc, stocks jumped up sharply, from 87,526 tons at June 30 to 106,112 tons at the end of July, of which the Government holds nearly 93,000 tons. Consumption, however, fell to 18,807 tons, all grades, from the June figure of 19,637 tons. Lead was in many ways the most interesting section of the statistics, for there was, for the first time for a long while, a drop in the U.K. stocks, which at June 30 had climbed up to 121,576 tons. At June 30, however, the total was 116,283 tons. Consumption improved to a total, all grades, of 23,746 tons, of which 10,051 tons was imported virgin, against 21,903 tons in June. It will be interesting to see whether the improvement is maintained in August. Consumption of tin in July was 1,898 tons, 160 tons higher than in June. It will be noticed in the foregoing figures that the usage of both copper and zinc declined and it begins to look as if there may be something in the contention voiced in some quarters that the second half of this year will not equal the first half in activity.

Conditions have been rather on the quiet side ever since the August Bank holiday. In the United States there is still persistent buying of Chilean copper and the E. & M. J. quotation, after dropping back, firmed up again last week. On the Continent electrolytic copper is available around £300 per ton, rather under than over, which is, of course, above the price ruling in the U.K. On the other hand, both lead and zinc are cheaper than they are here, the former selling at around £115 and the latter down to £100 or thereabouts for G.O.B. quality. Scrap metals are getting cheaper and holders are readily letting go on the permitted maximum prices allowed under the Ministry of Supply Order. Last Friday the American zinc price increased by ½ cent to 14½ cents and on Saturday the Ministry of Materials put its quotation up by £4 to £126 for G.O.B. quality. It has been announced that the copper price is to be maintained at its present level until further notice, which means in effect until either the Government or the producers give notice that they wish to terminate. The price is certainly very high, but as things look at present it is not easy to visualize any reduction over here.

In order to avoid misunderstanding about the disposal of Government lead stocks, the Ministry of Materials wishes it to be known that it is not its policy to release more than a relatively small tonnage for sale during the early months of the operation of the London Metal Exchange. The Ministry is satisfied that this tonnage will be adequate to meet the requirements of consumers. The metal to be disposed of will be made available through the London Metal Exchange and through the usual trade channels. The Ministry reserves the right to suspend selling when it is satisfied that sufficient lead is available from private sources to satisfy demand.

London Metal Exchange official tin prices:—

Cash—Thursday, £955 to £956; Friday, £952 to £953; Monday, £954 to £956; Tuesday, £959 10s. to £960 10s.; Wednesday, £960 10s. to £961.

Three Months—Thursday, £945 10s. to £946 10s.; Friday, £944 to £946; Monday, £945 to £946; Tuesday, £952 to £953; Wednesday, £950 to £951.

Iron and Steel Duties (Exemption) Order

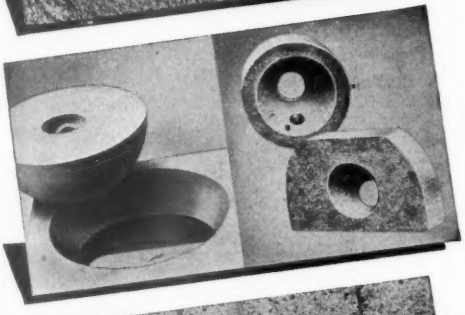
The Iron and Steel Duties (Exemption) Order, 1952, which comes into force on September 19, suspends the import duties on certain iron and steel goods for a period of one year. In the main, these goods are purchased centrally by the British Iron and Steel Corporation Limited, under an arrangement with the Ministry of Supply. The result of the present Order will be that for a period of a year from September 19, 1952, all imports of these goods, whether made centrally or privately, will be free of import duties, and the administrative arrangements will be simplified. The Order has no net effect on the position of the centrally-purchased imports (*i.e.*, on the position of the main part of total imports); under the arrangements prior to the Order, Customs duty on these centrally-purchased imports was refunded by the Ministry of Supply. The Order makes no change in the import licensing position. Copies of the Order, (S.I. No. 1670), can be obtained from H.M. Stationary Office, or any bookseller, price 2d.

A CONTRACT has been received by the Cleveland Bridge & Engineering Company, Limited, Darlington, from the British Electricity Authority for steel frames for turbine houses, boilerhouses, workshops, and stores buildings at the Stella North and Stella South power stations being built near Newcastle-upon-Tyne.

DURAX

THE INDISPENSABLE REFRACTORY!

★ *RAMMING PATCHING & MONOLITHIC LININGS*
★ *SPECIAL & EMERGENCY SHAPES · COMPLETE LININGS*
★ *THIN SOUND & STRONG JOINTING*



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Supplied ready mixed for immediate use. Suitable for rammed linings and patching existing Durax No. 1 or firebrick linings. Service temperature range 1300/1650°C.

DURAX No 2 — REFRACTORY CONCRETE

For casting in situ and making special shapes. Supplied dry. Special characteristics include—rapid setting as hard as firebrick: pours into position: no permanent volume change: little tendency to spall. Maximum service temperature 1300°C.

DURAX No 3 — REFRACTORY CEMENT

A finely ground air setting cement for jointing all types of firebricks. Supplied dry. Special characteristics include:—produces thin and strong joints: negligible shrinkage: highly refractory: economical in use. Maximum service temperature 1650°C.

★ *Fully descriptive literature on all of these grades of Durax is available on request.*

GENERAL REFRACTORIES LTD
Genefax House · Sheffield 10 · Tel. Sheffield 31113 (6 lines)

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

September 17, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 17s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. S), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £14 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 4s. 6d.; South Zone, £17 7s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £13 11s. 6d.; Scotland (Scotch iron), £13 18s.; Sheffield, £14 12s. 6d.; Birmingham, £14 19s.; Wales (Welsh iron), £13 18s.

Basic Pig-iron.—£12 10s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 28s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 31s. 7d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr.: max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £43 15s. 2d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASE: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £53 6s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £960 10s. to £961; three months, £950 to £951; settlement, £961.

Zinc.—G.O.B. (foreign) (duty paid), £126; ditto (domestic), £126; "Prime Western," £126; electrolytic, £130; not less than 99.99 per cent., £132.

Lead.—Good soft pig-lead (foreign) (duty paid), £131; ditto (Empire and domestic), £131; "English," £132 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £146 15s.; rolled zinc (boiler plates), all English destinations, £144 15s.; zinc oxide (Red Seal), d/d buyers' premises, — .

Other Metals.—Aluminium, ingots, £157; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £64 10s. to £64 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 27½d. per lb.; rods, drawn, 37⅜d.; sheets to 10 w.g., 32d.; wire, 33½d.; rolled metal, 30½d.

Copper Tubes, etc.—Solid-drawn tubes, 32⅜d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £205 to £218; BS. 1400—LG3—1 (86/7/5/2), £220 to £238; BS. 1400—G1—1 (88/10/2), £345 to £375; Admiralty GM (88/10/2), virgin quality, £375 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £355 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 44d. per lb.; sheets to 10 w.g., 46½d.; wire, 49½d.; rods, 44½d.; tubes, 42⅜d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb. (7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3⅜d. to 4s. 4½d.; to 25 in. wide × .056, 3s. 5⅜d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9⅜d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8⅜d.; 15%, 4s. 2d.; 18%, 4s. 6½d. All prices are net.

F. & M.
FERRO ALLOY BRIQUETTES

are the modern and easy method of adding Ferro Alloys to cast iron

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Direct from manufacturer to your foundry

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(for hardening and heat resisting)

SILICO-MANGANESE BRIQUETTES *(for scavenging and adding manganese to charges containing steel)* **FERRO-MANGANESE BRIQUETTES**

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Imports and Exports of Iron and Steel in July

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in July. Figures for the same month in 1951 are given for the purposes of comparison and totals for the first seven months of 1952 and of 1951 are also included.

Exports of Iron and Steel by Destination (tons)

Destination.	Month ended July 31.		Seven months ended July 31.	
	1951.	1952.	1951.	1952.
Channel Islands	863	653	5,392	4,366
Gibraltar	30	194	393	1,233
Malta and Gozo	280	202	1,931	1,469
Cyprus	351	872	3,002	3,505
Sierra Leone	632	463	3,212	3,240
Gold Coast	1,284	4,040	10,874	20,237
Nigeria	3,256	5,280	34,467	28,017
Union of South Africa	10,777	10,738	80,740	84,966
Northern Rhodesia	929	2,120	8,889	17,503
Southern Rhodesia	3,598	6,522	22,898	33,021
Tanganyika	1,171	1,012	10,776	12,530
Kenya	1,719	2,073	32,632	24,873
Uganda	536	173	3,291	3,876
Mauritius	452	601	4,187	3,649
Bahrein, Qatar, and Trucial Oman	317	1,688	4,178	10,307
Kuwait		421		9,498
India	7,678	6,868	56,891	44,648
Pakistan	3,690	6,579	47,631	45,704
Malaya	6,396	6,195	44,444	46,058
Ceylon	1,312	2,350	17,371	14,335
North Borneo	790	685	3,392	2,353
Hongkong	2,561	2,780	38,252	12,871
Australia	28,480	16,265	205,344	182,270
New Zealand	6,383	14,030	62,831	86,080
Canada	26,974	19,387	149,504	112,987
Jamaica	1,183	3,430	9,901	17,204
Trinidad	4,880	3,074	22,485	28,414
British Guiana	328	464	3,568	3,773
Anglo-Egyptian Sudan	544	1,252	5,601	10,994
Other Commonwealth	1,495	3,735	13,694	19,724
Irish Republic	8,948	3,778	56,471	36,550
Soviet Union	—	451	2,230	1,037
Finland	3,592	2,470	21,556	34,093
Sweden	10,422	10,245	62,844	70,275
Norway	4,289	5,763	39,967	37,548
Iceland	306	411	1,744	2,005
Denmark	6,306	5,135	51,073	50,674
Poland	36	12	579	99
Germany	71	82	696	852
Netherlands	8,783	9,987	54,490	59,652
Belgium	770	894	7,507	5,048
France	193	156	3,957	1,416
Switzerland	933	904	7,502	5,669
Portugal	930	748	9,055	5,379
Spain	642	499	2,774	5,120
Italy	3,933	363	22,052	7,207
Austria	54	35	330	353
Yugoslavia	1,150	446	6,159	3,208
Greece	179	170	1,749	2,090
Turkey	1,325	884	3,706	5,253
Netherlands Antilles	2,089	229	3,643	7,069
Belgian Congo	140	282	1,398	1,891
Angola	70	20	1,529	2,243
Portuguese E. Africa	255	456	2,208	3,042
Canary Islands	54	54	1,374	511
Syria	787	5	2,955	1,460
Lebanon	42	273	8,499	7,822
Israel	3,174	947	19,210	9,730
Egypt	6,954	3,231	26,549	20,752
Morocco	22	38	1,314	175
Saudi Arabia	78	1,158	314	4,488
Iraq	1,924	3,185	13,730	30,455
Iran	3,223	568	52,452	6,507
Burma	746	697	8,390	7,525
Thailand	913	942	9,852	5,723
Indonesia	695	1,152	4,615	9,466
China	—	183	4,597	191
Philippine Republic	449	685	2,368	2,850
USA	9,179	2,938	108,805	27,941
Cuba	165	139	2,686	1,390
Colombia	491	48	3,923	2,824
Venezuela	7,484	1,667	22,922	23,537
Ecuador	65	190	766	2,389
Peru	2,081	406	8,451	5,203
Chile	584	224	5,721	2,271
Brazil	2,591	1,582	14,484	15,031
Uruguay	413	85	8,027	3,153
Argentina	3,576	3,782	28,392	23,864
Other foreign	1,447	2,493	10,933	13,036
TOTAL	221,442	195,238	1,644,319	1,465,772

Imports of Iron and Steel and Origin (tons)

From	Month ended July 31.		Seven months ended July 31.	
	1951.	1952.	1951.	1952.
India	—	—	2	228
Canada	4,255	22,854	27,039	77,033
Other Commonwealth countries and the Irish Republic	173	526	961	2,835
Sweden	1,868	2,595	12,963	16,411
Norway	5,039	4,623	29,531	41,299
Germany	3,838	11,679	12,569	59,625
Netherlands	9,467	12,669	42,760	80,086
Belgium	21,830	31,839	97,001	184,829
Luxembourg	6,497	18,020	48,211	99,535
France	16,482	31,907	139,512	154,266
Austria	3,718	23,320	12,796	96,466
USA	2,287	45,597	20,246	379,493
Other foreign countries	437	49,105	1,855	139,288
TOTAL	75,891	254,734	445,446	1,331,394
Iron and steel scrap and waste, fit only for the recovery of metal	59,473	95,178	377,868	374,512

Exports of Iron and Steel by Group (tons)

Product.	Month ended July 31.		Seven mths. to July 31.	
	1951.	1952.	1951.	1952.
Pig-iron	392	429	13,657	2,440
Ferro-tungsten	—	10	284	99
Other ferro-alloys	303	227	1,478	2,138
Ingots, blooms, billets, and slabs	409	33	4,909	123
Iron bars and rods	419	217	6,042	2,182
Sheet and tinplate bars and wire rods	1,499	73	9,206	874
Bright steel bars	1,726	1,761	22,638	8,354
Alloy steel bars and rods	1,844	1,526	9,503	9,362
Other steel bars and rods	9,234	8,625	120,810	66,263
Angles, shapes, and sections	9,742	12,894	103,737	82,125
Castings and forgings	1,446	846	6,853	7,261
Girders, beams, joists, and pillars (rolled)	5,515	3,194	26,264	21,619
Hoop and strip	7,082	3,378	41,539	28,983
Iron plates and sheets	289	49	1,325	278
Tinplate	25,279	18,535	148,525	169,702
Tinned sheets	283	205	1,758	1,048
Terne plates and decorated tinplates	193	46	826	488
Other steel plate (⅛ in. thick and over)	20,436	18,999	170,910	138,871
Galvanized sheets	3,910	5,075	33,035	37,923
Black sheets	13,245	7,919	92,080	77,108
Other coated plates and sheets	789	828	5,751	6,261
Cast-iron pipes up to 6 in. dia.	8,909	7,325	46,172	52,759
Do., over 6 in. dia.	6,627	6,685	41,317	39,809
Wrought-iron tubes	31,911	36,548	234,126	254,319
Railway material	20,623	16,883	145,803	119,819
Wire	4,635	4,499	36,763	31,515
Cable and rope	2,842	2,811	18,019	18,199
Wire nails, etc.	2,371	927	17,312	6,639
Other nails, tacks, etc.	799	395	6,165	3,774
Rivets and washers	552	625	4,275	3,840
Wood screws	369	520	2,237	2,668
Bolts, nuts, and metal screws	2,282	1,569	16,112	14,431
Baths	1,264	901	8,159	9,326
Anchors, etc.	772	688	5,286	5,976
Chains, etc.	1,238	974	6,681	6,232
Springs	583	560	3,842	3,725
Holloware	2,664	2,248	21,606	20,925
Doors and windows	1,680	1,990	12,183	13,050
TOTAL, including other manufactures not listed above	221,442	195,238	1,644,319	1,465,772